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SIZES OF PIPES FOR HIGH PRESSURE GAS MAINS.

A Systematic Determination of Necessary Supply and Complete Analysis of Layout for Efficient Distribution.

By J. M. SPITZGLASS.

A prominent gas engineer once remarked that gas men are not as careful in selecting the sizes of their pipes, as are the electrical people in determining wire sizes; and attributed it to the fact that investigation of the nature and amount of losses incidental to conducting electrical energy along wires has been carried on intelligently for many years, and the principles discovered by the experimenters have been systematically formulated and placed at the disposal of everyone interested. On the other hand, the subject of gas distribution through pipes has received scant attention, and reference to the results of experimenters reveals a distressing lack of uniformity in statements of the principles involved. It is noticeable that among the employees of every firm dealing with the distribution of electrical energy a number of men may be found who are able to handle any problem of this kind that arises, because electrical science has been systematized to a state where it can be taught as an elementary subject by text books; while the subject of gas distribution has not attained the same high state of perfection, and the principles are not thoroughly defined. The method of working out gas distribution is very complicated and involves so many laborious calculations that very few have the patience to work them out in the proper way.

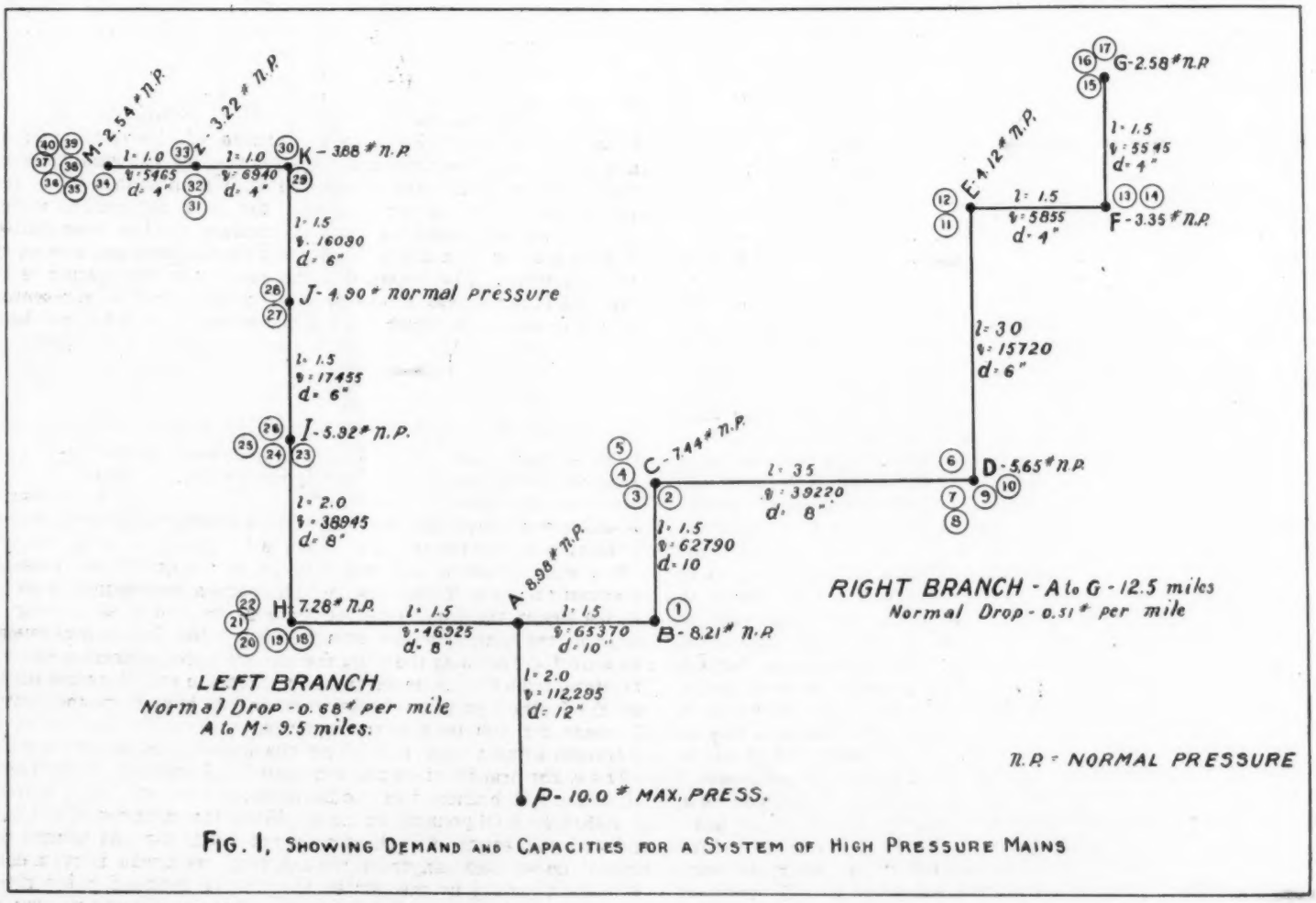

FIG. 1, SHOWING DEMAND AND CAPACITIES FOR A SYSTEM OF HIGH PRESSURE MAINS

It has been the privilege of the writer to make exhaustive tests on the flow of gas through pipes, and while working along this line he made a systematic study of the basic principles of the flow of

fluids, and modified the existing formulas in accordance with the results of the tests. His experience, extending over a number of years, has enabled him to simplify the methods of working out cases of gas distribution, The following example, taken from an actual case, will illustrate the method used in determining the sizes and capacities for a system of high pressure gas mains.

Fig. 1 is the diagram of a territory to be supplied with natural gas (sp. gravity 0.50) from a point "P" at one end, where a maximum pressure of 10 pounds per square inch is to be maintained on the main. The diagram is made up after an investigation of the probable number of consumers and their expected consumption. Each consumer is marked by a number in a small circle indicating on the diagram his location, and reference to the accompanying table (1) shows the expected consumption from each one.

In the table, the expected load of each consumer is given in cubic feet per month. The load being mainly for manufacturing purposes, it is assumed that it consist of 26 10-hour days, or a total of 260 working hours. For a possible variation in the hourly consumption of gas, an addition of 20 per cent. is allowed to make up the quantity necessary for the maximum hour. This, given in the third column of the table, determines the capacity for which the supplying mains have to be figured.

TABLE 1.—*Estimated Consumption of Gas.*

No. of Consumer.	Cu. Ft. per Month.	Max. Cu. Ft. per Working Hour.	No. of Consumer.	Cu. Ft. per Month.	Max. Cu Ft. per Working Hour.
1....	560,000	2,580	21....	160,000	740
2....	1,600,000	7,100	22....	1,000,000	4,620
3....	1,000,000	4,620	23....	2,000,000	9,240
4....	1,500,000	6,930	24....	400,000	1,850
5....	1,000,000	4,626	25....	1,250,000	5,780
6....	500,000	2,310	26....	1,000,000	4,620
7....	290,000	1,340	27....	160,000	740
8....	2,900,000	13,400	28....	135,000	625
9....	1,250,000	5,780	29....	400,000	1,850
10....	145,000	670	30....	1,600,000	7,400
11....	135,000	625	31....	2,700	125
12....	2,000,000	9,240	32....	135,000	625
13....	27,000	125	33....	135,000	625
14....	40,000	185	34....	40,000	1,850
15....	40,000	185	35....	160,000	740
16....	160,000	740	36....	400,000	1,850
17....	1,000,000	4,620	37....	37,000	170
18....	40,000	185	38....	80,000	370
19....	27,000	125	39....	135,000	625
20....	1,000,000	2.310	40....	80,000	370

The next step is to mark off on the main or trunk line, a number of pressure points as determined by the converging branches, or by an appreciable change in the quantity delivered through the main. These points are indicated by heavy dots, and designated by letters A, B. C, etc., on the diagram. The length of main or segment between adjacent points is marked on the line with letter "l" and given in miles and fractions of a mile.

To determine the capacity to be provided for in each section or part of the main, it is best to begin at the furthest point of each branch, working toward the initial point of distribution. Table 2 shows the procedure of adding up the quantities to be delivered through each segment of the diagram. The table is divided into "left branch" and "right branch" columns corresponding to the diagram. The first column designates the part of the main by the letters of the pressure points at the ends, beginning with the furthest part from the initial point of distribution. The second column gives the length of the section; the third column shows by number the consumers that have to be supplied from each part of the main; the fourth column the supply necessary for each consumer in cubic feet per hour, and also the cumulative total that has to be supplied at each pressure point. By following this method of reversing the order of the points, much labor and confusion is avoided in the figuring, and the total in the supply column added up against each pressure point shows directly the quantity that has to be delivered through the part of main preceding the given pressure point. These quantities are marked with letter "q" under the length of each segment of main on the diagram and given in cu. ft. per hour.

It is now necessary to determine the sizes of the pipe to be used for such part of the main line. From the nature of the conditions, there is always more than one way to handle the situation. The problem is to choose the way that will prove the most economical in the end.

For highest efficiency in the delivery of the gas, the drop of pressure through the main should be distributed evenly over the whole length of the line. Since the drop of pressure in a given

TABLE 2.—*Hourly Discharges Through Main.*

Left Branch				Right Branch			
Part of Main.	Length in Miles.	Consumer No.	Max. Supply Cu Ft. per Hour.	Part of Main.	Length in Miles.	Consumers No.	Max. Supply Cu, Ft. per Hour.
M to L..	1.0	40	370	G to F..	1.5	17	4,620
.. ..		39	625	.. ..		16	740
.. ..		38	370	.. ..		15	185
.. ..		37	170				
.. ..		36	1,850	at G.			5,545
.. ..		35	740	F to E..	1.5	14	185
.. ..		34	1,340	.. ..		13	125
at M			5,465	at F.			5,855
L to K..	1.0	33	625	E to D..	3.0	12	9,240
.. ..		32	625	.. ..		11	625
.. ..		31	125				
at L.			6,840	at E			15,720
K to J..	1.5	30	7,400	D to C..	3.5	10	670
.. ..		29	1,850	.. ..		9	5,780
				.. ..		8	13,400
at K.			16,090	.. ..		7	1,340
J to I...	1.5	28	625	.. ..		6	2,310
.. ..		27	740				
at J.			17,455	at D.			39,220
I to H...	2.0	26	4,620	C to B..	1.5	5	4,620
.. ..		25	5,780	.. ..		4	6,930
.. ..		24	1,850	.. ..		3	4,620
.. ..		23	9,240	.. ..		2	7,400
at I.			38,945	at C.			62,790
H to A..	2.5	22	4,620	B to A..	1.5	1	2,580
.. ..		21	740				
.. ..		20	2,310	at B.			65,370
.. ..		19	125	A to P..	2.0	..	....
.. ..		18	185	Left Branch			46,925
at H.			46,925	at A-total			112,295

pipe line is proportional to the square of the velocity of the gas in the pipe, the minimum drop for a given volume of gas will result only when the gas is delivered with a uniform velocity over the whole length. If the velocity of the gas is different in various parts of the line, the total drop of pressure for the same delivery will be greater than if the velocity were maintained uniform at the average value. For instance, if the velocity in one section of the line is 1 foot per second, the drop of pressure will be represented by the square of 1, which is 1; if the second section has a velocity of 2, the drop will be represented by the square of 2, which is 4; if the third section has a velocity of 3, the drop will be represented by the square of 3, which is 9. The average velocity will be 2 feet per second, $\frac{1+2+3}{3} = 2$, and the average of the drops is

$$\frac{1+4+9}{3} = 4\tfrac{2}{3}.$$

If this average velocity were maintained throughout, the drop is represented by the square of 2, which is 4; therefore, with the uniform velocity there is a saving of 14 per cent. of the pressure necessary for a given delivery, which means a corresponding saving in the power required to deliver the gas.

To secure a more or less even velocity in the line, it is necessary to adjust the sizes of the pipe for the various discharges, so as to require about the same drop per mile at the end as at the beginning of the liae. In our proposition we have 10 pounds initial pressure for the maximum discharge, with the furthest point on the right branch 14.5 miles from the initial point of distribution, and the farthest point on the left branch 9.5 miles from the point, *A*, which is the division of the branches.

Assume a final pressure of 2.5 pounds at the extremes of the line.

The Right branch will stand a drop of 7.5/14.5=0.51 pounds per mile; the left branch, from point A to the end, will stand a drop of 6.48/9.5=0.68 pounds per mile. With this data for the drop, and with the length of each part of the main, and the volume as marked under each length on the diagram, we proceed, by means of a rule designed by the writer (Fig. 2), to read off the corresponding sizes for each part of the line. The use of the rule, which does away with all intricate mathematical calculations, will be illustrated presently, following a brief discussion of the origin al- formulæ upon which the results are based.

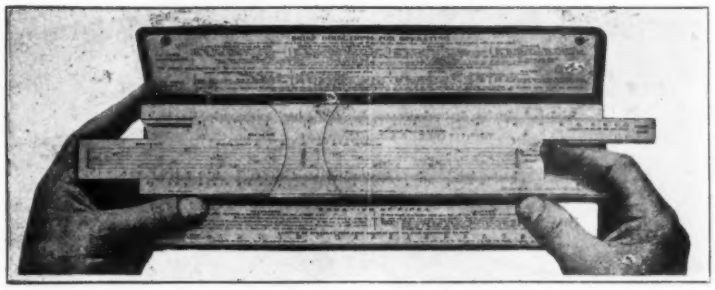

Fig. 2.

Let p be the drop in pressure in pounds per square inch.
l, the length of the pipe in miles.
m, the mean pressure in the line, pounds absolute.
s, the density of the gas, referred to air.
d, the inside diameter of the pipe in inches.
q, the discharge through the pipe in cubic feet per hour.

then

$$q=64.3\sqrt{\frac{p\ m\ d^5}{l\left(1+\frac{3.6}{d}+0.03\ d\right)}} \quad \ldots\ldots\ldots (1)$$

This formula, representing the equation modified by the writer according to experimental data, gives the mathematical relation of the above quantities to each other. Solving for the diameter, we have

$$d=\frac{1}{.28}\sqrt[5]{\frac{q^2\ s\ l\left(1+\frac{3.6}{d}+0.3\ d\right)}{p\ m}} \quad \ldots\ldots (2)$$

Equation 2 shows the relation of the inside diameter of the pipe to the fifth root of the quantities represented by the letters under the radical sign. It will be noticed that "d" appears on both sides of the equation. Still the equation can be solved by assuming a trial value for "d" under the radical and, if necessary, correcting it after the trial solution. It would be necessary to solve equation 2, probably more than once, for each one of the thirteen branches in our example, and each solution would only be used as a guide to the nearest size pipe on the market. This would lead to the solution of equation 1, to determine the capacity of the pipe in each branch; and the solution of another form of equation 1, to ascertain the drop of pressure in each part of the main from the delivery of the desired amount of gas through the given size of pipe.

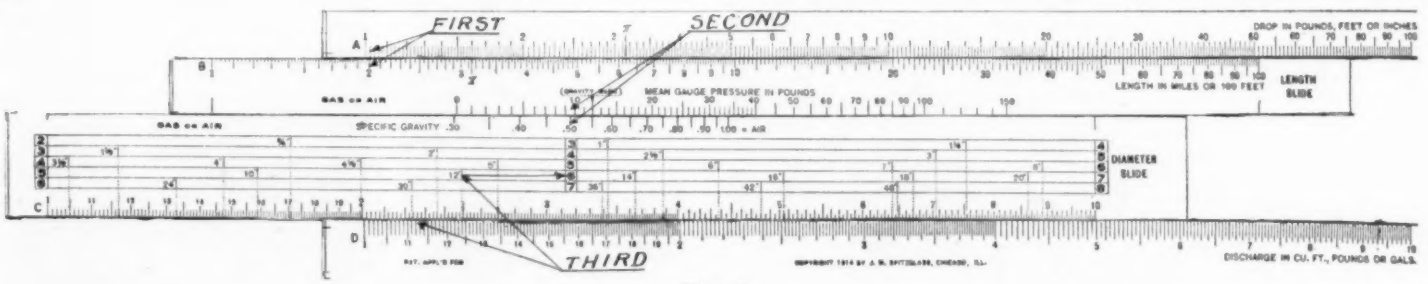

Fig. 3.

The use of the slide rule for this purpose will now be illustrated. By reference to Fig. 3, we see on the face or the Rule six scales for the six quantities involved in our figuring. Reading from top to bottom the scales are arranged in the same order as the letters given above to represent the quantities, The top or "A scale" designates the drop, the "B" scale the length, the "C" scale the mean gauge pressure, the "D" scale the specific gravity, the "E" scale, divided into five columns, designates the diameters, and the last scale the discharge in cubic feet per hour. The directions are merely; set the two known pairs in line, and opposite the known fifth quantity—read the sixth. Fig. 3 illustrates how this was done for the part P-A of the main in our example.

For that part we have given:

Drop of pressure.....0.51 pounds per mile
or 1.02 pounds for 2 miles.
Length of pipe.....2 miles.

Mean pressure in line $= \frac{10+8.98}{2} = 9.5$ pounds gauge.

Specific gravity.....0.50
d = ?
q = 112,295 cubic feet per hour.

1. Set 2 (miles) on the length-scale, to 1.02 (pounds) on the drop-scale.
2. Set 0.50 specific gravity, to 9.5 mean gauge pressure.
3. Opposite the number 1.123 (representing the quantity 112,295 cubic feet) read the nearest largest diameter (12″) in the row corresponding to 6 integer places (the number of integers in the quantity 112,295).

It is essential to note that the capacity of the 12-inch pipe for the conditions is more than the required quantity; the reading under the line extended from the 12-inch diameter is 1.24 representing 124,000 cubic feet (since the 12-inch diameter is in the 6 integer row). This quantity is then marked down for future reference as the normal capacity of the part P-A. If it is desired to find what the drop would be when only the required quantity (112,295 cubic feet per hour) passes through the line, it is done merely by shifting the slides to the left until the 12-inch diameter lines comes over the desired quantity, as shown in Fig. 4. The drop now is shown to be only 0.425 pounds per mile (42.5 pounds for 100 miles) or a total of 0.85 pounds over 2 miles, the length of P-A.

From point A, we have two branches. Following through the Right branch first, the part A-B a mile and a half long, has to deliver 65,370 cubic feet per hour with a drop of 0.51 pounds per mile. Setting the Rule as we did for the part P-A, the only change being that the specific gravity 0.50 is set to 8.60, the mean gauge pressure for the normal of 0.51 pounds per mile in the part A-B; we find that the nearest diameter in the 5 integer row to the number 6,537 (representing 65,370) is 10 inches. Assigning this diameter for the part A-B we note on the rule the discharge quantity of the 10-inch pipe for the contemplated drop of 0.51 pounds per mile to be 77,500 cubic feet. This quantity is set down as the normal capacity of the part A-B.

For the part B-C the mean gauge pressure for the normal drop is 7.83 pounds, the delivery is 62,790 cubic feet and the length 1.5 miles. Setting the rule again to the drop of 0.51 pounds per mile and the corresponding mean gauge pressure, we find that the size is to be 10″ (the same as A-B) and the normal capacity of the part B-C is 76,000 cubic feet per hour.

In the part C-D, 3.5 miles long, the mean gauge pressure for the normal drop is 6.55 pounds, and the required delivery 39,220 cubic feet per hour. Setting the rule at the drop of 0.51 pounds per mile, and 6.55 mean gauge pressure, we find that the nearest diameter is 8i nches, and the normal capacity of the part C-D 41,500 cubic feet per hour.

The part D-E is 3 miles long, the mean gauge pressure for the normal drop is 4.90 pounds, and the required delivery 15,720 cubic feet. Setting the rule for these figures, we find the nearest larger diameter is 6 inches, and the normal capacity of the part D-E 19,600 cubic feet per hour.

The part E-F is 1½ miles long, the mean pressure for the normal drop 3.75 pounds, and the acquired delivery 5,855 cubic feet per hour. Setting the rule to these figures, we find the nearest larger diameter to be 4″, with a normal capacity of 6,400 cubic feet per hour.

In the last part of this branch, F-G, 1½ miles long, the mean gauge pressure for the normal drop is 2.95 pounds, and the required delivery 5,545 cubic feet per hour. Setting the rule to these figures we find the nearest larger diameter to be 4 inches with a normal capacity of 6,230 cubic feet per hour.

In the same way we go through the left branch, where the normal drop is 0.68 pounds per mile. The part A-H is 2½ miles long, the seam gauge pressure for the normal drop of 0.68 pounds per mile is 8.13 and the required delivery 46,925 cubic feet per hour. The rule will show that the diameter of pipe to be

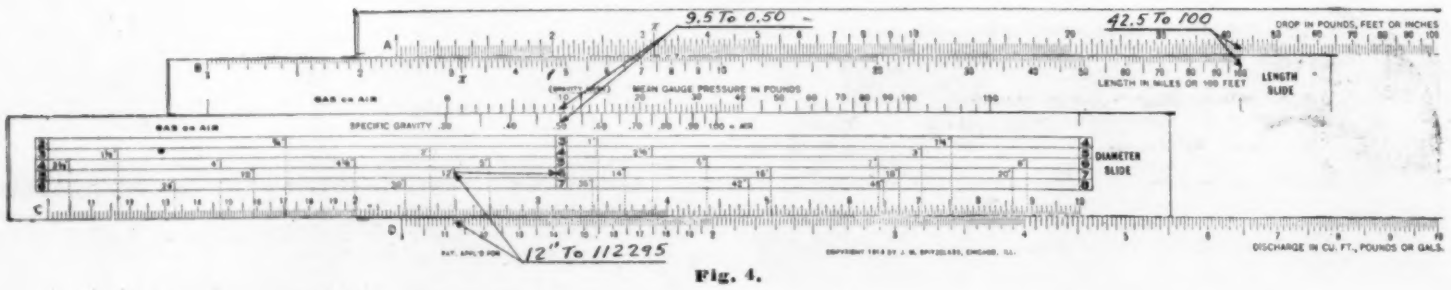

Fig. 4.

used is 8 inches, with a normal capacity of 49,500 cubic feet per our.

In the part H-I, two miles long. the mean gauge pressure for the normal drop is 6.60 pounds and the required delivery 38,945 cubic feet per hour. By setting the Rule to these figures we find the nearest larger diameter to be 8 inches with a normal capacity of 47,800 cubic feet per hour.

In the part I-J, 1½ miles long, the mean gauge pressure is 5.40 pounds, and the required delivery 17,455 cubic feet per hour. Setting these figures shows the diameter to be 6 inches with a normal capacity of 22,900 cubic feet per hour.

In the part J-K, 1½ miles long, the mean gauge pressure is 4.38 pounds, and the required delivery 16,090 cubic feet per hour. By the Rule we find this diameter to be 6 inches with a normal capacity of 22,300 cubic feet per hour.

In the part K-L, 1 mile long, the mean pressure is 3.53 pounds and the required delivery 6,840 cubic feet. Setting these figures will show the diameter to be 4 inches with a normal capacity of 7,320 cubic feet per hour.

In the part L-M, 1 mile long, the mean pressure is 2.85 pounds, and the required delivery 5,465 cubic feet. By the Rule we find the diameter to be 4 inches with a normal capacity of 7,200 cubic feet per hour.

A summary of the figures for the various parts of the main is tabulated as follows:

TABLE 3.—*Sizes and Capacities of the Various Parts.*

Part of main.	Mean pressure at normal drop.	Size inches.	Required Delivery cu. ft per hour.	Capacity at normal drop cu. ft. per hour.	Excess cu. ft. per hour.
P-A.....	9.50	12	112,295	124,000	11,705
A-B	8.60	10	65,370	77,500	12,230
B-C.....	7.83	10	62,790	76,000	13,210
C-D.....	6.55	8	39,220	41,500	2,280
D-E	4.90	6	15,720	19,600	3,880
E-F.....	3.75	4	5,855	6,400	545
F-G.....	2.95	4	5,545	6,230	685
A-H	8-13	8	46,925	49,500	2,575
H-I.....	6.60	8	38,945	47,800	8,855
I-J	5.40	6	17,455	22,900	5,445
J-K.....	4.38	6	16,090	22,300	6,210
K-L	3.53	4	6,840	7,320	480
L-M.....	2.85	4	5,465	7,200	1,735

The excess in capacity refers only to the given part of main. It cannot be supplied, however, unless covered by a corresponding excess in each previous part of main from the initial point of distribution.

In every case of laying gas mains a great deal of consideration is given to the question of future growth. If an increase in the average load is expected in the near future, it is better to figure the mains for the larger capacity. If the expected increase is of a nature to have a maximum for short periods of time only, it will be more economical to take care of the short time maximum by an increase in the initial pressure. In any case it is imperative to have a complete analysis of the proposition before the sizes of mains are ordered.

If the analysis had to be made by solving the formulas directly, few would have patience to carry out the calculations. With the aid of the flow computer the data is obtained without making complicated calculations, and therefore, a complete analysis of any problem similar to the one here presented may be made in a reasonable length of time.

ACCORDING to *Science et Art de l'Eclairage* the total consumption of incandescent mantles in the world approaches 300,000,000 yearly, of which 50,000,000 are used in France, she producing approximately a half. The war has had a disturbing influence on the industry, and she is apparently unequal to supplying her own consumption even in normal times.

Die Casting.

The Metal, its Use and the Gas Appliance Used.

[From the paper presented at the N. C. G. A. Mid-Year Conference, by C. E. CHAPPLE.]

Castings made by injecting by means of pressure, molten white metal into steel molds or dies, are known as "Die Castings." Only white metal alloys melting between 500° and 800° F. have thus far been available for die castings. These alloys consist of various combinations of zinc, lead, tin, copper, antimony, aluminum and bismuth; the fire first five being most commonly employed.

Gas fuel is essential to the many stages of die casting manufacture on account of the necessity for close control of temperatures. Should the metal be heated excessively the losses due to volatilization will be large and the change in composition of the alloy by this would be fatal. High temperature also shortens the life of the dies, the most expensive part of the die casting equipment; this on account of increasing the cracking of the steel. On the other hand, if the metal be insufficiently heated, the molds will not be completely filled and the castings resulting would be worthless. This condition of close temperature regulation is best met by gas fuel. Other fuels have been tried, and fallen down completely.

Die castings occupy relatively the same place in the machinery world as drop forgings. They offer a means of cheaply supplying small metal parts,cast with such accuracy that they require practically no machining, being within 1 or 2 thousandths of an inch of correct size and having surfaces of great smoothness. The metal is not as strong as brass, and on this account their use is restricted to work not subjected to severe stresses. Their field is in parts for automatic vending machines, automobile lamp bodies, very small electric motor frames and end shields, gears for prepayment meters, raceways for door locks and a multitude of other work of this nature.

In perhaps no other industry is gas fuel so extensively employed in the various processes of manufacture. In order that this may be comprehended, a list of applications of gas fuel follows, with a brief description of the appliance and treatment required.

Uses of Gas Fuel in the Process.—

Treatment of die-cutting tools.
Annealing, hardening and tempering dies.
Melting copper to make primary alloy.
Melting zinc.
Melting and making final mixture.
Melting and keeping molten, metal in die-casting machine.
Heating ladles.
Heating die to receive the metal.

Treatment of Die-Cutting Tools.—These tools are made of either carbon or high speed tool steel; the treatment of which calls for use of standard oven furnaces, high speed steel furnaces, lead hardening furnaces, and cylindrical hardening furnaces of suitable size to meet conditions of the work.

Annealing, Hardening and Tempering Dies.—The dies are generally made of 0.60 to 0.80 carbon tool steel, the treatment of which calls for standard oven or semi-muffle furnaces and oil tempering furnaces. The oil tempering furnaces may be fired with either atmospheric or blast burners. For treatment of carbon tool steel see data sheet on carbon steel treatment.

Melting Copper.—On account of the high melting point of copper (about 1950° F.) a crucible furnace or other type of high temperature melting furnace is required. In one large plant a No. 2 Hawley down-draft melter (Fig. 1) is used in connection with a positive pressure blower, which boosts the gas to 1 pound pressure, the air being supplied to burners at 12 ounce pressure. This furnace melts 400 pounds of copper in 35 minutes, using 1,800 cubic feet of gas. This size and type of furnace was selected on account of the furnace bottom being large enough and sufficiently hot after the copper is melted to admit of the addition of cold antimony and tin to make the primary alloy, without the application of further heat.

Fig. 1.—Gas Fired Hawley Down Draft Melter.

Melting Zinc.—Zinc is melted separately from the other metals used, so that it may be purified and cast into pigs for convenience in making the final mixture. (Fig. 2 and 3.) On account of the high specific heat of zinc (0.0956), it should be melted in a furnace using positive blast burners. When heated above its fusing point (780° F.) zinc has an affinity for iron and absorbs iron from the pot, which forms a thick dross that settles in the bottom of the bath. On this account, a furnace with burners playing on the side of the pot, rather than the bottom, is desirable.

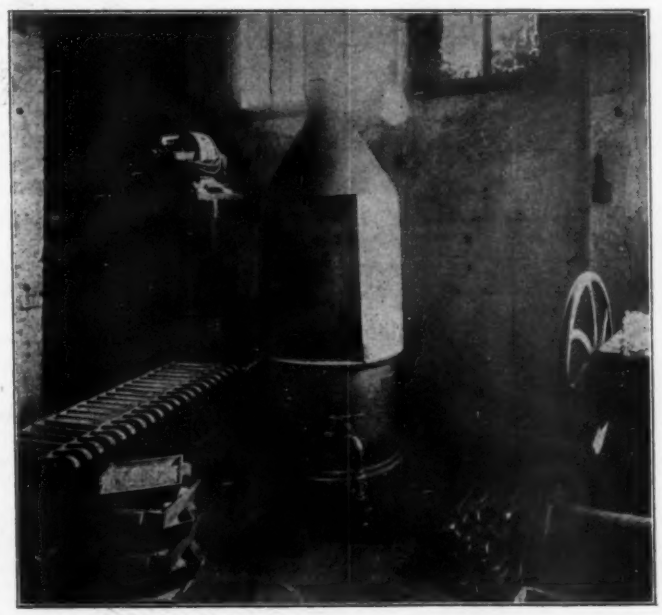

Fig. 2.—One type of zinc melting furnace.

Melting and Making Final Mixture.—The use for which a die-casting is intended, and the nature of the casting from a foundry viewpoint, make it necessary to pour castings from alloys of different compositions. It is, therefore, desirable that the final mixture of metals be made in comparatively small batches—generally in soft metal furnaces of 500 to 700 pounds capacity. As the fusing point of final mixture is about 670° F., these furnaces may have either atmospheric or blast burners.

Melting and Keeping Molten Metal in Die-Casting Machine.—The die-casting machine proper generally consists of a rectangular soft metal furnace, having a pot approximately 10 by 18 by 6 inches deep and with a sufficiently wide flange at the top to permit of the die-casting mechanism being bolted to it. This mechanism consists of a hand operated plunger and receiver by means of which the molten metal is forced from the pot into the die (Fig. 4).

There is generally left in the die-casting furnace from the previous day's work, a small quantity of metal that has to be remelted, which calls for burners in the furnace for this purpose. After this metal is melted and new metal added, the function of the burner is merely to take care of loss of heat by radiation. For this reason, atmospheric burners may be safely used, and because of their ease of control, should be employed.

Fig. 3.—*A*—Crucible furnace for melting copper. *B*—Alloying furnace. *C*—Zinc melting furnace.

Heating Ladles.—To prevent chilling of the metal while it is being transferred from the mixing pot to the die-casting machine, it is generally considered good practice to keep the ladle used for that purpose heated. This may be done by hanging it over a small bunsen or urn burner.

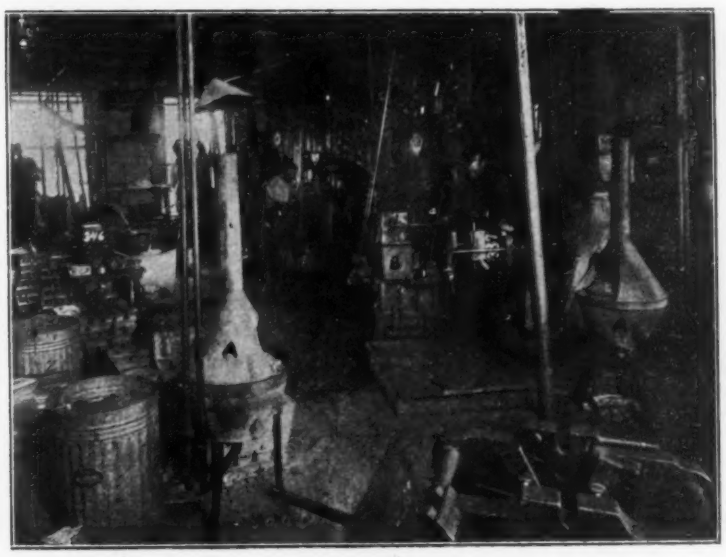

Fig. 4.—A small die casting plant. *A*—Final alloy batch melters. *B*—Die cesting machines.

Heating the Die.—If, in starting the die-casting machine, the hot metal is forced into the die without pre-heating the latter, the die will soon give out, due to surface crackage. As the dies are very expensive, their cracking must be avoided, which is done by heating the die to a temperature near that of the metal. Blast brazing burners or ordinary bunsen burners made of 1 inch pipe are satisfactory for this purpose.

To Make Fuel Gas.—Since the adoption of hydro-electric current for street lighting in St. Catharines, Ontario, the revenue of the St. Catharines municipal gas plant has fallen off so rapidly that it is too small to justify a continuation of the manufacture of illuminating gas. The management of the plant is now estimating the cost and making arrangements for the production of a cheaper gas for fuel purposes only, which it is expected will successfully compete with natural gas.

WELDING OF HIGH PRESSURE MAINS.

[From the paper by J. D. SHATTUCK, written for A. G. I. Meeting.]

The practice of distributing artificial gas at pressures greater than 5 pounds dates practically from 1899, when F. H. Shelton laid 5 miles of 3-inch pipe from Phoenixville to Royersford, Pa. for 30 pounds pressure; this line being immediately followed by similar extensions in the Philadelphia suburban district under direction of the writer. One criticism that can be made of the early installations is that the designers did not take full advantage of existing knowledge in the natural gas and oil fields, and that they used inferior material and workmanship. The first high pressure lines were in many cases laid with ordinary pipe, cast iron fittings and rubber packed expansion joints, which, following natural gas practice, were supposed to take care of expansion due to temperature changes. Natural gas costs nothing to manufacture, and, therefore, leakage is not as important as to the artificial gas engineer, and rubber joints will last longer on natural gas lines than on artificial.

It has been found that cast iron fittings and expansion joints will not do. With the best valves and screw pipe obtainable transmitting artificial gas at 45 pounds or higher, serious leakage will occur. Every high pressure plant installed with 30 pounds working pressure will soon step up to higher pressures with the growth of the business. The writer feels that the only solution is to lay welded lines with welded drips, tees, etc., heavy steel hydraulic valves, welded pressure tanks and welded services.

A high pressure plant, 30 pounds working pressure, designed to sell 25,000,000 cubic feet or less per annum, would have an additional operating cost of nearly 10 cents a thousand for compression, and an additional leakage of probably 10 per cent. above the normal low pressure system, if screw pipe were used. This would mean that an engineer would he justified in spending $25,000 more than the cost of such a high pressure system to make it low pressure, and if his gas cost him 40 cents a thousand at the holder, he could spend another $10,000 on plant investment, due to the saving in leakage.

When High Pressure may be Employed.—1. Not if low pressure can be used without too great capital expenditure.

2. Not if medium high pressure with blowing units can be used.

3. Only when interest charges are greater than cost per thousand of compression.

4. To connect widely separated plants.

5. To add or develop new towns (cut to low pressure at such towns if compactly built).

6. If passing through small towns, individual house governors can be used.

As sales increase and the capacity of compressors are reached, duplication and redesign of compressor stations become expensive and would pay for many low pressure mains.

TABLE 1.—*Horse-Power Required to Compress 1,000 Cubic Feet of Gas per Minute.*

At	15 lbs.	50	H.-P.	
"	30 "	85	"	
"	45 "	111	"	
"	60 "	134	"	
"	80 "	117	"	two stages
"	100 "	151	"	"
"	200 "	212	"	"

There are many small high pressure installations that show leakage percentages of 20, 30 and even 50 per cent. of the gas manufactured. Installations are being made to-day, through which it is a question if a profitable gas business can be long maintained. The writer has seen plants where the gas is compressed into tanks at 80 pounds to save holder expense, and then sent out through a station governor to a low pressure system. The cost of compressing the gas was nearly 10 cents per thousand, which very soon would pay for the difference between the compression tanks and compressor, and a small gas holder. Compression tanks and condensers should be welded, as it is almost impossible to make riveted tanks absolutely tight, and a small leak in a tank under 80 pounds pressure amounts to a good deal in a year.

There are certain advantages in working at pressures even up to 200 pounds—for instance sulphur all removed in the resulting condensate. (See E. C. Jones on "The Effects of High Pressure upon Illuminating Gas." 1906 Proceedings American Gas Institute.) It is true candle-power losses are considerable, but extensive experiments show the B. t. u. losses only 4 to 5 per cent., while candle power losses run from 25 to 35 per cent.

In a low pressure system we provide for future years growth by adding small pressures, as four times the pressure on a low pressure system doubles the capacity. To double the delivery of a high pressure system, takes three times the pressure; so a system designed to carry 30 pounds pressure may easily work up to 100 pounds, to keep up with the growth of the territory. No screw pipe system will be tight enough for future proposed pressures. To carry 200 pounds, welded joints must be substituted for screwed joints in mains and services. Strap saddles will not do, nor plug cocks. It is proposed to substitute for the cock, a steel or brass valve similar to an ammonia valve, but with blank ends that can be welded, and packed with a soft lead packing, or a dry graphite packing upon which the gas has very little effect.

The fittings inside the customers cellar are a source of danger. A cock (Fig. 1) has been designed for this purpose which can be

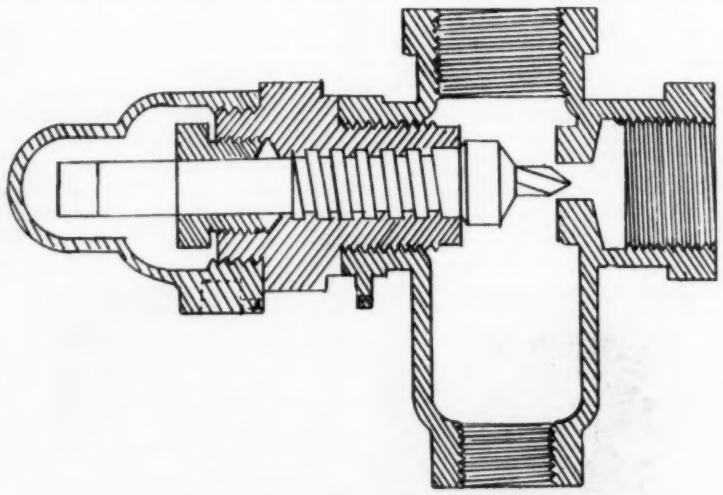

Fig. 1.—Improved Service Valve.

opened or closed without straining the service pipe, and repacked and cleaned out on the service. By using these valves, welding services to the main, and welding the services, there will be a bottle-tight system without screw joints into the consumer's cellar. A plug cock sometimes becomes so stiff that there is danger of breaking off the ¾-inch service at the cellar wall, especially after the pipe has become rusted. Protection for the service pipe is shown in Fig. 2.

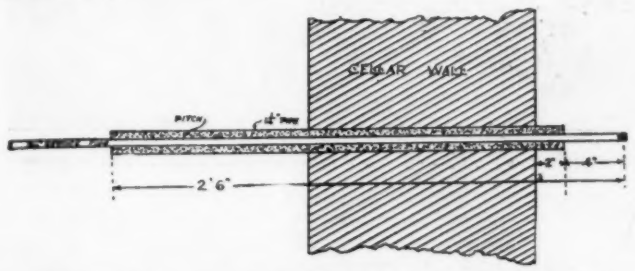

Fig. 2.—High Pressure Service Pipe Protector through Cellar Wall.

Fortunately the handling of high pressure gas has been practically without any serious accidents, but they may become more frequent due to weakened pipe, as lines increase in age.

I believe when the gas engineer realizes how great the leakage can be on a screw joint line, or a rubber expansion jointed line, that he will not be satisfied with anything but a welded line. Leakage on a line carrying 30 pounds or over is bound to be excessive on any screw jointed line with saddles and plug cocks, no matter how well the work has been done. Eighty miles of line, put in several years ago by the writer, using full weight line pipe and the best saddles and plug cocks obtainable, shows leakage under 10 pounds pressure between 1 A.M. and 4 A.M. at the rate of 98,000 cubic feet per mile of 3 inches, or 1½ pounds loss; and under 30

pounds pressure 165,000 cubic feet per mile of 3 inches or 2½ pounds loss.

Generation of Acetylene.—An acetylene generating plant can be located in a separate building convenient to the repair shop, so that the gas may be piped to the benches and connections made for torches; and will provide gas for working pressures up to 15 lbs. for shop use, and for compressing gas into cylinders up to 150 lbs. compression. These cylinders are filled with a porous substance and a solvent (acetone) which absorbs 25 times its volume of acetylene gas for each atmosphere pressure. Acetone weighs about 6½ pounds to a gallon, and 1 gallon equals 0.1336 cubic feet.

On each cylinder the maker stamps the total weight, including that of the acetone. Before refilling the cylinder it should be weighed, and if found light acetone should be added.

The acetylene gas from a pound of carbide is estimated at 4½ cubic feet, and costs in the gasometer about $\frac{5}{16}$ cents per cubic foot., and about 1 cent when compressed into tanks. Gas bought from a manufacturer will cost about 1¾ cents f. o. b. factory.

A complete plant for generating gas and compressing into tanks would consist of the following:

1 Generator, capacity 100 pounds of carbide, producing 100 cubic feet of acetylene per hour.
1 Acetylene gasometer, capacity 100 cubic feet.
1 Purifier, with full charge.
1 No. 1 Mechanical drier.
1 No. 2 chemical drier, charged.
1 Oil separator.
1 Special three-stage acetylene compressor.

This would cost $2,500 complete, including one welding and cutting outfit as listed below.

Welding Outfit.—A single welding and cutting outfit consists of the following:

2 Compressed acetylene cylinders, 12 inches by 36 inches, capacity 225 cubic feet, weight filled, 185 pounds.
1 Style "C" manufacturer's torch, with tips Nos. 1, 2, 3, 4 and 5.
1 H. P. acetylene regulator.
1 L. P. oxygen regulator.
1 Oxygen cutting regulator.
1 Style "C" cutting torch, with 3 tips.
1 24-foot length acetylene hose.
1 24-foot length oxygen hose.
1 24-foot length oxygen cutting hose.
2 Pair heavy smoked goggles.

To complete this outfit, oxygen cylinders are necessary which can be purchased or will be loaned by the manufacturer of the oxygen. The writer has found it advantageous to own at least two cylinders for each outfit. They contain 100 cubic feet and as it requires about 1.14 cubic feet of oxygen to one of acetylene for a properly regulated flame, at no time should less than two of these cylinders be on hand. They cost $22.50 each. A machine cutting torch with circular attachment would be a profitable addition, particularly useful for shop work, where most of the flange and drip work for a line could be done in advance of the work in the field.

The acetylene cylinders given above are a good size to handle, but if the work is of considerable extent, it would be better to use cylinders 16 inches by 48 inches, which have a capacity of 500 cubic feet and weighing from 350 to 400 pounds.

Acetylene Torches.—The low pressure torch works on the injector principle, the oxygen, admitted under a fairly high pressure, draws in the acetylene. This torch will use either dissolved acetylene or acetylene from either low pressure or high pressure generators. The pressure type, known in the United States as the "high pressure" torch, uses both gases under a pressure of a few pounds, consequently it must be supplied with dissolved acetylene, or acetylene from a high pressure generator. In the cutting torch, several small oxy-acetylene jets pre-heat the work for an additional jet of oxygen, which does the cutting by oxidation. Part of the metal is removed as an oxide, and the heat melts the rest so that it runs out of the cut.

Theoretically, the proportion of the gases are 2 of acetylene to 5 of oxygen. which combine to form 2 volumes of carbon dioxide and 1 of water. This reaction is not completed in the inner cone, the acetylene and oxygen burning to only carbon monoxide and hydrogen because the temperature is above their dissociation, so further combination occurs in the outer envelope. Most of the oxygen in this second step is taken from the surrounding air. The tip of the inner cone is the working point of the flame, although its total heat is less than that of the larger outer envelope. The heat in the latter is not wasted, but serves to preheat the work for the inner cone, prevents the inner cone from being cooled by the inert nitrogen of the air, and protects the molten metal from oxidation, the combining carbon monoxide and hydrogen having a greater affinity for oxygen than the metal.

Every gas works should have an oxy-acetylene welding and cutting torch, and tanks of oxygen and acetylene. These tools come in very handy for making welds for various pieces of machinery, retort doors, broken lamp posts, automobile repairs and numerous other jobs. To cut an 8 inch pipe with pipe cutters often takes 15 to 30 minutes, according to the position it is in, whereas with the cutting torch it can be done in 2 minutes.

There are several makes of torches on the market, all of which will do good work, However, on account of their convenience for field work, the writer's reference will be confined to the "Medium or High Pressure Torch," designated as C. and B. torches.

The style "B" cutting torch is a 2-base model, a by-pass valve supplying the extra cutting jet of oxygen, the valve being opened or closed by a slight movement of the thumb. This torch is convenient to handle, light in weight and constructed with a view to great durability and efficiency. Our standard welding torch is the style "C" manufacturers' torch. It is furnished with tips No. 1 to No. 5 and will weld metal from 1/32 to 5/16 inch thick. Tips Nos. 6 and 7 will enable thicker metal to be welded with this comparatively small torch. For heavy welding the large style "C" torch should be used, which comes with tips No. 6 to No. 10, and will permit of welding metal above 5/16 inch thick.

The style "B" welding torch is very efficient and economical in operation. It is made in 2 sizes, each size fitted with 5 tips for different thicknesses of metal. A melting attachment may be used with it, thus making of it a combination torch. Two oxygen regulators and 2 separate lines of oxygen hose are used; one supplying the oxy-acetylene flame and the other for the jet of cutting oxygen.

The welding rods used should be carfully selected of Norway or Sweedish iron. A complete generating and welding outfit is given hereafter in detail.

Welders.—Good welders can be made of men of a fairly mechanical turn, blacksmith's helpers, fitters or helpers that have worked on gas furnaces and have some idea of heats. This work does not have to be as well finished as the usual shop jobs, so professional welders are not required. A smart laborer soon becomes very expert in the use of the torch, and able not only to make joints with no pressure on the line, but to weld service connections and sleeves over existing expansion joints with 35 pounds pressure in the mains without burning holes through them.

The first joints will be rather expensive, but as the men become familiar with the process they gain rapidly in the amount of work they can do. Our experience in 1911 showed that an experienced welder can do 4 4-inch joints per hour. Mr. E. C. Jones gives 25 4-inch joints as an 8-hour working day; or 1,000 feet of pipe 40-foot lengths per man per day. On 2-inch pipe we have welded as high as 12 joints per hour, and individual 2-inch joints in 2½ minutes. Mr. Jones gives costs covering sizes up to 16 inches.

Figs. 3 and 4 are photographs of the first welded high pressure

Fig. 3.—Welding a tee on the under side.

(*Continued on page 58.*)

THE AMERICAN GAS LIGHT JOURNAL

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CHARLES H. WADELTON, Secretary and Manager.

SANFORD K. CAMPBELL, Editor.

NEW YORK, MONDAY, JANUARY 25, 1915.

Standards of Quality.

If a Commission, as was done by that in the Second District, New York, in refusing a demand by a consumer for a special kind of electric current because none of those delivered by the company suited his purpose, declines to specify what quality of current (voltage, direct or alternating, etc.), companies shall furnish, is it not as logical to leave to gas producers the quality (B. T. U.) of their commodity?

As has been pointed out so often, the question of what figure will enable the gas company to give the largest number of heat units for a dollar depends upon coals and other materials available, and is best determined by the experienced producer. The price at which the product is sold should be subject to Commission regulation and also the character of service, but the quality of gas, within limits efficient in standard appliances, should not be determined by what is made or can be made in some other place or with other materials.

High Pressure Distribution.

The paper by Mr. Spitzglass, dealing with sizes of pipes, and what we print of Mr. Shattuck's paper on "Welding High Pressure Mains," are together and separately of great value. The first shows the right way to understandingly dissect a proposition and design its parts in keeping with requirements on each section of the main system and the lay-out as a whole. By his method it is possible to easily make comparisons of schemes carrying various initial pressure or sizes of pipe; a thing almost impossible if all the necessary computations have to be made by figuring out the formulae for each question. Mr. Shattuck is a recognized authority and pioneer in the branch he treats—the laying of high pressure mains—and his paper, the final part of which will appear next week, is a valuable resume of latest practice, besides giving his personal recommendations in many instances.

Costly Experiments That Few Heed.

The "Wall Street Journal" has been investigating the operating of gas and electric lighting plants by municipalities, and under date of December 28, 1914, prints the following with the caption "Cost of Municipal Ownership":

"The 'Seattle Times' has been digging up some figures on the cost of municipal ownership to Seattle, and asks the citizens to consider the showing before going deeper into the experiment. Eleven years ago Seattle began its municipal ownership career by authorizing an expenditure of $590,000 for a hydro-electric station at Cedar River, using the surplus of the city's water supply. Today the people of Seattle have invested their good money, and have obligated themselves in the form of bond issues for municipally owned public utilities, including street railways, to the amount of $7,323,819.

"Bonds for light and power supply and for street railways aggregate $4,794,000 and the light and power plant now owes the general and other funds of the city $530,000 and the street railway has a deficit of $111,200. While the population of Seattle has increased fourfold in 11 years, the debt of the city has grown twelvefold in the same period.

"An exhibit of the financial condition of the city shows a total overdraft in various funds of $1,800,000, with the lighting and power departments owing $530,000 to the city, the street railway $111,200, with $900,000 immediately required for pressing needs of city and with the light and power plants demanding $500,000 additional to extend the city light plant by day labor."

The Dye Situation.

Two things transpired last week that have a bearing upon the proposals for American and English production of coal-tar dye stuffs. The first was the arrival of the American steamship Matanzas from Rotterdam with a million dollar cargo of German dyes. The second, an announcement from London that the Government's scheme for the formation of a national company to manufacture analine dyes, the making of which Germany has heretofore monopolized, has been abandoned, according to the "Daily Express," owing to the failure of the interested firms to provide the capital. The present scheme will be withdrawn, says the "Express," and some new plan formulated.

[Official Notices.]

New Jersey State Gas Association.

Office of the Secretary,
Newark, N. J., January 13, 1915.

The midwinter meeting of the New Jersey State Gas Association will be held at Glassboro, on Tuesday, January 26th, opening at 11 A.M.

The following papers will be read:

"What is Being Done by Manufacturers of Appliances to Encourage the Use of Gas as a Fuel?" Mr. Stanley Grady.

"Is the Sale of Gas-Electric Fixtures by Gas Companies Desirable?" Mr. Robert Ffrench Pierce.

It is expected that the association will join the Philadelphia Gas Meeters at dinner at the Hotel Adelphia at 6:30 P.M.

Yours very truly, O. F. Potter, Secretary.

New England Association of Gas Engineers.

The Forty-fifth Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, Thursday and Friday, February 18th and 19th, 1915.

Papers are being prepared as follows:

"New Vertical Settings at Fall River," C. W. Hunter, Boston.

"Concrete Piles for Holder Foundations," F. E. Drake, Lynn.

"Free Maintenance of All Gas Lamps by Gas Companies," J, P. Conroy, New York.

"Industrial Fuel Gas," W. H. Bradley, Springfield.

"B. T. U. Losses on Medium Pressure Lines," W. O. Brewer, Meriden.

Mr. H. N. Tolles, of Chicago, will address the meeting and be at the annual dinner.

Applications for Membership should reach the Secretary by February 17th. N. W. Gifford, Secretary.

Pennsylvania Gas Association.

West Chester, Pa., January 9th, 1915.

The Pennsylvania Gas Association, will hold their Annual Meeting in Philadelphia, on April 14th, 15th and 16th. The headquarters will be at the Hotel Adelphia, one of Philadelphia's leading hotels.

A splendid programme has been planned, including excellent papers by well-known men. The entertainment features are in the hands of gentlemen whose reputation has been established for something original and interesting.

It is hoped all members and their friends will be on hand, to make the meeting "Better than ever."

Yours very truly, W. O. Lamson, Jr., Secretary.

[Special Telegraphic Report.]

FOURTEENTH ANNUAL CONVENTION, WISCONSIN GAS ASSOCIATION.

MILWAUKEE, WIS., January 20, 1915.

The fourteenth annual convention of the Wisconsin Gas Association was opened by President James H. Walker, at Hotel Pfister this morning. The roll call was dispensed with as registration was still in progress, and reading of minutes of previous meeting was omitted, they having been published and distributed. Report of Executive Committee was deferred until afternoon session. Secretary-Treasurer's report covering period from May 1 to January 15 showed balance cash on hand of a little over $1,000, and total membership 96 Active and 83 Associate.

President Walker's address was mainly devoted to the work of the Association. Relative to possible future joint meetings with the Electrical Association, he charged the members to give careful thought to the advantages and disadvantages of combination shown by the present meeting, in order that they might vote understandingly and without prejudice upon the question. On the proposed consolidation of the American Gas Institute and the National Commercial Gas Association, and the absorbing of all state associations as sectional parts of the combined national bodies, he said, though not desiring to influence the action of the convention, it seemed to him that affiliation of this Association as an association, not as individual members, with such a combination would be productive of great good. The interests of gas companies involving State legislative action must be taken care of by State associations. The social relations brought about by annual conventions tend to harmonize our actions in a business way and make co-operation in our State a positive factor. To our associate members too much praise cannot be extended for their hearty co-operation and support, and our success has been largely due to their efforts and to their cheering presence at the meetings.

The President's address was referred to a committee consisting of Messrs. Lounsbury, Harr and Gregg, to report at a later session.

The Nominating Committee named was Messrs. Wortendyke, Grant and Kraft.

The first formal paper read was that by W. C. Butterworth, on "Cost and Price of Gas in a Small City," a very interesting description of medium sized operating, that started a good discussion lasting until lunching time.

Afternoon Session.—At the opening of this afternoon's session a congratulatory message was received from Mr. E. C. Jones, President of the American Gas Institute, extending an invitation to our members to attend the meeting of the International Gas Congress, in San Francisco, in September.

"The Why and How of Semi-Indirect Lighting," by R. F. Pierce, was the next paper read, giving the superior points of that system of illumination and the latest appliances developed for it. Then followed the paper by G. H. Cook, on "Commercial Aspects of the Application of Demand Principles to Rates for Gas Service," a timely treatise on a subject of increasing interest and importance.

The Committee on President's Address, in reporting, complimented Mr. Walker on its scope and treatment of the subjects; and recommended that the arrangement for joint meeting with the Wisconsin Electric Association be continued for at least another year or two, but that a later date in the year be selected for the meeting. On motion the report was accepted and the question of time and place of the next meeting referred to the Executive Committee.

The report of the Nominating Committee was then presented, naming the following gentlemen, who were unanimously elected:

President.—W. C. Butterworth, Platteville.
Vice-President.—W. E. Haseltine, Ripon.
Secretary-Treasurer—Henry Harman, Milwaukee.

Mr. Butterworth accepted the office and the honor done him in a few graceful words; and the session adjourned until Thursday morning.—H. and H.

MILWAUKEE, WIS., January 21, 1915.

This morning's session is a joint one with the Wisconsin Electrical Society, our President, J. H. Walker, presiding. The first paper read was that by Mr. R. O. Jasperson, on "Advertising Influence of Public Service Employees," a subject on which Mr. Jasperson is particularly competent to speak and which he covered so well that it was voted to publish his paper in pamphlet form for general distribution among gas and electric utilities throughout the State.

The "Financing of Public Utility Properties," by Mr. Andrew Cooke, was next heard, and was particularly timely considering financial conditions. These papers and their discussions filled the time until lunch hour.

Afternoon Session.—This afternoon's session was with President Korst, of the Wisconsin Electrical Society, in the chair. The first paper read was that by Mr. E. J. Maxwell, on "The Continuous Meter Reading and Discount System," a subject that is becoming of great interest to our larger companies. Mr. E. N. Strait, Statistician of the Wisconsin Railroad Commission, then read his paper on "The Wisconsin Railroad Commission's Method of Rate Making," which gave the hearers a very clear idea of what the Commission required, and should be of value to many of them in the future.

Then came Mr. Edwin Gruhl's paper, on "Increased Taxation in Wisconsin and its effect on Public Service Companies." This subject is rarely discussed in association meetings, but is of enlarging importance, and the paper and its discussion were closely followed. The last paper taken up was the "Practical Effect of the Workman's Compensation Act." by Mr. Carl Muskat. Mr. Muskat has made a close study of the Act, as an attorney, and his comments and statistics were most enlightening.

The Wisconsin Gas Association Convention then adjourned, and to-morrow's session will be devoted exclusively to the Wisconsin Electric Society.

Our total registration is 80 members, nearly 50% of the total and not a bad showing for a "poor" year.

To-night's joint-association banquet in the Fern Room of the Hotel Pfister was a great success. Two hundred and seventy gas and electric men participated. Mr. F. C. Morehouse acted as Toastmaster, and the principal speaker was Mr. Opie Reed. All the best utilities of the State were represented, and many prominent gentlemen spoke briefly.—H. and H.

ILLUMINATING ENGINEERING SOCIETY.

At a meeting of the Council of the Illuminating Engineering Society, on January 14, in the general offices of the Society, 29 West 39th st,, New York, Mr. M. Luckiesh, chairman of the Committee on School Lighting, submitted the manuscript of a paper on "Safe-guarding the Eyesight of Children," which, with some seventeen or eighteen slides, is to be used as a lecture on school lighting for presentation at meetings of school authorities throughout the country. Copies of the lecture will be available for other interested parties.

A proposal to create a class of members to be known as "Fellows" was received and after reasonable discussion was laid on the table.

Upon recommendation of the Committee on Editing and Publication it was voted to advise technical and trade journals that papers of this Society may be reprinted in whole or in part subsequent to the dates of presentation, provided proper credit is given.

The following committee appointments were confirmed:

Committee for Remodeling the Lighting of the General Offices: H. E. Ives, chairman; Clarence L. Low and Thos. W. Scofield; advisory members, L. B. Marks and George W. Cassidy.

Committee on Factory Lighting: C. E. Clewell, chairman; W. A. D. Evans, T. J. Litle, Jr., R. E. Simpson and G. H. Stickney.

Committee on Constitutional Revision: W. D. Weaver, chairman; Louis Bell, L. B. Marks, Preston S. Millar and C. H. Sharp.

Committee on Popular Lectures: C. F. Scott.

Twenty-four applicants were elected to membership in the Society.

(*Continued from page 55.*)

Welding of High Pressure Mains.

installations in this country, a 4 inch line, laid by the writer in July, 1911. The process was brought to his attention through the welded steam headers that were being installed in steam plants, and notices in the foreign papers that street mains were being welded in Germany and France, and about this time in England.

Fig. 4 —Welding apparatus as used on 4-inch line.

Welding Pipe.—The method of welding pipe is simply the butting of the ends together in a fairly straight line, on a smooth roadway or on skids over the trench. After a few lengths are welded together, the skids may be removed and the pipe lowered into the trench as the work proceeds, or the pipe can be welded in sections with two or more gangs working at the same time, then dropped into the trench, and the final connection welded in the trench.

The more snake-like horizontally the pipe is laid in the trench the better, as it tends to relieve contraction strains. The pipe should be carefully graded, however, as in low pressure work.

No care is necessary in dropping the pipe into the trench, as the weld is as strong or stronger than the pipe itself.

The advantage of welding outside the trench is that the pipe can be turned, enabling the welder to always work on the upper diameter. The pipe can be welded underneath if necessary, as the fluxed material does not drop, but tends to hang to the pipe.

The end of pipe, 2 inch and over, should be slightly chamfered at about 30 degrees, so that when the ends are butted there is a "V" formed, not more than ¼ inch across the top. As the thickness of metal increases a good rule is that up to plates of ¾ inch the width of the "V" should about equal the thickness of the metal. Chamfered pipe can be had at an additional cost per length of 3½ cents for 2 inch, 4¼ cents for 3 inch, and 8 cents for 4 inch pipe. To offset this, there is a 2½ per cent. saving in cost of plain end pipe over threads and coupling.

In welding two ends of pipe together, Norway iron is used. To make the pipe fairly straight it is necessary to weld a small piece on one side of the pipe, and then a small portion directly opposite tacking the pipe together, and then complete the weld.

A welder and two assistants to roll the pipe can make joints of ordinary sizes. After completing a weld the welder moves the hand truck and two tanks forward to the next joint, while the helpers are rolling the next pipe into position. We have designed a small galvanized truck which can be locked at night, and shades the tanks from the sun during the day. (Fig. 5.)

In extending a line from existing gas mains, there is little danger of explosion when the main is below 6 inches, but for that size and over great care should be taken. Before making a final weld for a connection of this nature, it is well to fill the line with gas, and bag off each side of the weld, thus making a very small section of pipe that may possibly contain an explosive mixture.

The process of welding one pipe to another is very simple. Connections to the blow-pipe are made from the cylinders of compressed oxygen and acetylene, the pressures being reduced by regulators and reducing valves to pressures for the different sized tips and thickness of metals as shown in Tables 2 and 3.

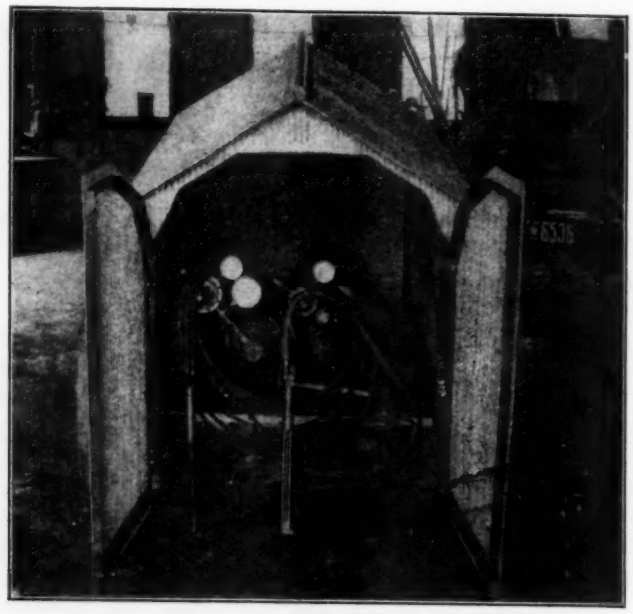


Fig. 5.— Complete Welding Outfit for Street Work.

TABLE 2.—*Approximate Acetylene and Oxygen Pressures for Style "C" Welding Torches.*

Tip No.	Acetylene Lbs.	Oxygen Lbs.	Thickness of Metal Inches.
1	1	2	1/32–1/16
2	2	4	1/16–3/32
3	3	6	3/32–1/8
4	4	8	1/8 –3/16
5	5	10	1/4 –5/16
6	6	12	5/16–3/8
7	6	14	7/16–1/2
8	6	16	1/2 –5/8
9	6	18	5/8 upwards
10	6	20	5/8 upwards

TABLE 3.— *Approximate Pressures for Style "C" Two-Hose Cutting Torch.*

Tip No 2. Acetylene Thickness of Metal.	Tip No 2. = 2 to 3 lbs. Oxyven Pressure.	Tip No. 3. Acetylene Thickness of Metal	Tip No. 3. = 3 to 4 lbs. Oxygen Pressure.	Tip No. 4. Acetylene Thickness of Metal.	Tip No. 4. = 4 to 5 lbs. Oxygen Pressure.
¼ in.	10 lbs.	1 in.	20 lbs.	3 in.	40 lbs.
½ "	20 "	1½ "	30 "	4 "	50 "
¾ "	30 "	2 "	40 "	5 "	60 "
1 "	30 "	3 "	50 "	6 "	70 "
1½ "	40 "			7 "	80 "
				8 "	90 "
				9 "	100 "

Welding Service Connections Under Pressure.—To make a service connection, a socket can be used, one end of which has been ground to the approximate radius of the pipe, and although this is not absolutely necessary, material will be saved by doing it. (Fig. 6.) When making a service connection to a new main that has been tested for leaks by gas pressure, it is necessary to thoroughly purge

Fig. 6.—Welding Service Connection.

the main before the flame is brought in contact with the pipe. After the socket has been welded to the main, the main can be tapped in the usual manner, and the service run to the cellar, each length being welded as in main work.

If a small hole is burned in the main, ream it out, drive a steel plug in the hole and weld it over.

To make sure there is no leak in the welding of the socket to the main, it can be connected to the oxygen tank and pressure put on the socket, or a cylinder of compressed air can be carried for testing services. A number of interesting experiments were made to determine the effect of burning holes through the main. With a small hole. the gas was easily extinguished by a wet blanket. With a large hole, where the flame spreads so that it is not safe to approach close to it, a piece of pipe large enough in diameter to cover the hole and 12 feet to 15 feet long, is held upright over the flame, combustion then taking place at the end of the pipe. The pipe can be thrown over quickly or moved horizontally away from the line, carrying the flame with it and extinguishing the fire at the main.

A ⅛-inch hole in the main at 3 pounds pressure will blow out the low pressure torch. A ¼-inch hole requires about 10 pounds to blow out the torch.

Sleeving.—We are at present welding over our rubber joints, which, in some of our early lines, were put in every 500 feet.

The following method can be employed for removing expansion joints: If the joint is under inexpensive pavement, 30 feet of the line should be uncovered, the expansion joint taken off, the line raised, a sleeve of the proper length and of the next larger size of pipe slipped over one end, the pipe lowered, and the sleeve moved to cover the opening. It should then be caulked with asbestos wicking. and a slight gas pressure permitted to come against the joint, care being taken to purge the line of air. The ends of the sleeve can then be welded to the main. If the line is under expensive pavement, a split sleeve can be employed, and the expansion joints completely covered.

Strength of Welds.—The Testing Bureau of Swarthmore College ma de a number of tests for us of pieces of pipe welded in the field by our men. They were joints as they ran, and four out of five were stronger than the pipe itself. The tests show: Not only that the weld is stronger than the pipe, but that the stretch in the pipe without rupture is a great many more times than any possible temperature contraction that would occur after the pipe was in the ground. In other words, no provision need be made to take care of temperature contraction in a welded line as far as the line itself is concerned. If steel valves are used they will stand the strain, however, the bolts in the flanges may stretch enough to cause a leak. Slack should be forced into the line at and near valves. The best way to insure this is to lay the line, bolting the valve flanges together without the valves and then raising the line back of the proposed valve until the flanges are separated far enough to insert the valve. After inserting the valve drop the line back into the trench. Fig. 7 shows longitudinal sections of one joint. Notice especially the solid metal through the weld.

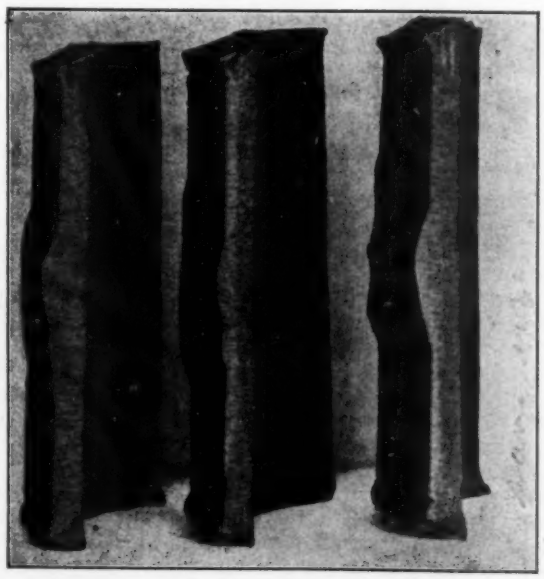


Fig. 7.—Welded Joint Sawed Longitudinally.

Expansion and Contraction.—According to the Bureau of Standards, the coefficient of expansion of welded boiler tubes between 0° C. and 200° C. is:

Charcoal iron	0.00001235
Bessemer steel	0.00001258
Seamless O. H. Steel (hot finished)	0.00001239

The expansion of 100 feet of pipe, given in tables of *Practical Engineer*, are as follows:

Temperature	Cast iron. Inches.	Wrought iron. Inches.	Steel. Inches.
Up to 50° F.	0.36	0.40	0.38
100° F.	0.72	0.79	0.76
125° F.	0.88	0.97	0.92

The physical properties of ordinary steel pipe are as follows:

Tensile strength...	52,000 to 62,000 pounds per square inch.
Elastic limit.....	Not less than 30,000 " " " "
Elongation in 8" ..	" " " " 20 per cent.
Reduction in area..	" " " " 50 " "

The tests of Swarthmore College show that the pipe that we welded is about in accord with these figures. From these it will be readily seen that the contraction of a long length of pipe would have to occur all at one point to cause a rupture of the pipe. Therefore, I feel that we are fully justified in not providing for expansion in laying welded lines under ordinary conditions, where the temperature changes at 3 feet below the ground cannot be greater than 33° minimum and 75° maximum, a range of only 43°.

We have used lead gaskets under service saddles and between valve flanges. Welding the service to the main does away with these, and besides the money saved, does away with the element of leakage. It is a question whether the gaskets used on the valve flanges should not be of some other material. This is the only point where we have not thoroughly eliminated the possibility of leakage. Companion valve flanges are made up with short pieces of pipe welded to the flanges to avoid screwed joints.

Bending.—Wrought iron or steel pipe 12 inches and smaller can be bent cold in the field, if the radius of the bend is not less than given in the table.

Size of Pipe (Inches).	Advisable Radius-R (Inches),	Minimum Radius-R (Inches).
2½	15	10
3	18	12
3½	21	14
4	24	16
4½	27	18
5	30	20
6	36	24
7	42	28
8	48	32
9	54	36
10	60	40
11	66	44
12	72	48
13	84	60
14	90	68
15	100	76
18 O. D	125	90
20 O. D	158	120
22 O. D	165	132
24 O. D	180	144

Costs.—Mr. L. B. Jones, Engineer of Distribution, Pacific Gas and Electric Company, gives a comparison of the cost of welding an 8-inch line and a line laid with couplings, as follows:

	Feet.	Labor.	Material Supplies Sundries.	Teaming.	Total.	Cost per Foot.
Welded.....	4,770	$2,305.59	$2,609.55	$125.00	$5,040.14	$1.06
Couplings (rubber gaskets)....	4,350	$2,527.70	$2,476.55	$89.00	$5,093.44	$1.17

On the jointed line, laborers received $2.50 per day, but on the welded line they were paid $2.75 per day. Owing to the disintegration of the gasket the jointed main will require manintenance, with labor and repaving cost, while the welded main will never require any further attention.

Our welding costs on 4-inch and under have not been very different from screw pipe, principally because the runs were short and not much opportunity to work up to speed. A recent 4-inch line, 7 miles long, was run for the Concord Gas Company, Concord, North Carolina, under my direction, and the cost was very low, largely due to digging machinery. Outside of cost, the saving in leakage is going to be a big operating item. On 6-inch and larger the pipe gang saving is considerable.

An ideal day's work on 4-inch pipe is 1,000 feet, employing 13 men and 1 foreman, 2 men on trenching machine, 3 with the welding outfit, a road roller equipped with a scraper and 2 men, 1 man following with a tamping machine, and 5 extra men to clean up and lower pipe from time to time; vs. the old way—50 laborers, 2 foremen, and the work not so well done. Small companies who are not justified in maintaining a digging machine can contract for its use and save labor troubles and money over hand digging.

Fig. 8.—4-Inch Pipe Bent Cold with Weld in Bend

Troubles.—The troubles of a high pressure system come when the capacity of the line is being approached. The liquid hydrocarbons, if not removed at the plant, collect in pockets in the mains, sometimes irrespective of drip locations. These liquids, as they get further away from the plant dry out and leave a fine black powder, practically free carbon mixed with some iron and perhaps naphthalene, and form stoppages in mains and services. The gas also suffers from a loss in its B. T. U. and candle power, due to compression and transmission. It is easy to enrich high pressure gas at distant points. With a fall in pressure, the gas will pick up light oils at comparitively low temperature (40° and 45°) after a drop of 10 to 20 pounds in pressure from an initial 30 pounds.

The distribution troubles are confined, as a rule, to the governors getting out of order, which generally means simply the renewing of the disk or diaphragm. This is discovered through complaint made by the customer, either of low pressure or pressure that blows the safety seal. The trouble with individual governors is more than offset by the uniformly satisfactory pressure that can be given the customer, and different pressures can be given for various industrial uses. There is a big future for high pressure lighting, in which compressed gas will aid.

An emergency outfit for handling high pressure breaks or leaks should be kept handy to an automobile, so that complaints can be taken care of immediately. High pressure demands more alert handling than is generally given to low pressure.

New methods and wrinkles are being discovered almost every day, and there is no doubt but that we have entered upon a new method of laying high pressure gas mains, and that pressures will tend to increase in high pressure work as they have in low pressure in the past. The saving in leakage will justify many heretofore unprofitable extensions.

(To be Continued.)

Need Not Supply Special Current.

The Public Service Commission, Second District, New York, has decided that it would be unreasonable to order the Municipal Gas Company, of Albany, to supply all the kinds of current that might be needed by its consumers, and has dismissed a complaint that asked that the company be directed to supply low voltage direct current suitable for use in the "spotlight" on a theatre's stage. Commissioner Irvine, in the opinion, points out that the company does not refuse to supply several kinds of current, namely 500 volt direct current for power, and four kinds of alternating current for lighting and power, and is willing to supply any of these if the theatre will install its own apparatus for transforming or stepping down the current to the kind of voltage it requires.

Results of the War for Public Service Commissions to Consider.

[By HENRY FLOY, in *Electrical World.*]

To the casual reader there would seem to be no connection between the European war and the regulation of public utilities in America. But to one who weighs the matter it will be seen that not only must the war affect the practices of public regulating bodies, but that it has already begun to have such an influence. In a few months the European war has shown what would ordinarily have taken years to demonstrate clearly: namely, that the regulations and decisions of our public utility commissions are only ephemeral and must be revised from time to time. It has shown that questions answered by public regulating bodies with the best light available and with more or less assurance that permanent solutions have been reached, cannot be considered as finally settled, but must rather be held to have been answered only for the time being, and will always require amending and re-settling, depending upon shifting conditions and fluctuationg financial markets. The professional philanthropist has been accustomed to argue that once regulation became effective, the rates of a corporation could be so fixed as to permit earnings that would provide an exact and minimum so-called fair return on the property used, and that under such circumstances there would be no need for further consideration of the subject, except possibly to order reductions in rates from time to time as inventions, improvements or increased business allowed increasingly larger earnings to be realized.

Interest rates are likely to continue higher than in the recent past owing not alone to conditions which have prevailed since the war began, but also to the inevitable after-effect of greater demands for capital for reconstruction and the re-creation of property lost and wasted. In common with other corporations, utilities have felt the results of the general public demand for reductions in the profits of corporate properties, and many operating under commission regulation find the cost of money too high to permit them to make additional capital investments with assurance that the regulating bodies would permit the higher rewards at present demanded by capital. Consequently new constructions has been curtailed to the minimum, and expenditures for absolutely necessary improvements have been financed by short-time notes or similar obligations.

Almost uniformly the precedents and decisions of state commissions and courts thus far have held that, while it is necessary to provide for operating expenses, an allowance for depreciation and a return on the value of the property, nothing at all, or at least no special allowance was required to cover exigencies or contingencies. The result is that utilities generally have been forced to pay out all of their earnings to maintain their standing and conserve the market value of their securities. Now that the European war has created unusual demands for money and capital is insisting on increased rewards, prevailing rates for services in all the markets of the world must be increased if public utility corporations are to be able to secure the additional capital required for their constantly growing properties.

Aside from the war, the primary reason for the pinched position in which some public utilities find themselves, is the failure of the individuals on some of the state public service commissions to adopt a statesmanlike attitude towards the problems brought before them.

The policy of regulation is in serious danger when it is possible for men who have never shown any particularly great business sagacity or engineering ability, mediocre lawyers and individuals whose chief recommendations have been activity in behalf of municipal ownership or increase in the number of state or municipal employees, to be selected as public service commissioners.

Executives and managers of public utility properties, having devoted their time and energies to the construction and operation of such properties, usually have won their positions, paying as much as $25,000, $50,000 or even higher salaries per year, as a result of competition and proved qualifications. In some states public service commissioners receiving $2,500 to $5,000 a year are passing on business matters involving $100,000,000, although they have never shown ability to originate or participate in any large business enterprises. Such men cannot be expected to understand and appreciate—and, as a matter of common knowledge, they do not—the necessity for scope, flexibility and allowance for some freedom of action in large affairs. Sometimes men are appointed to commissions who have the ability to grow, and they enlarge their viewpoint so that after a few years of service they develop the proper judicial attitude and render decisions that are constructive and

liberal and fair to both the public and the companies. The result of the European war must make these public servants appreciate that rates for capital will vary with money conditions; that while commissions may be able to force reduction of rates, they cannot compel investors to put capital into unattractive or unremunerative enterprises. Rates for capital must be made attractive and comparable with returns allowed in other and equally risky enterprises, or no money will be forthcoming to provide the extensions of property required by utilities.

The European war has therefore hastened recognition and appreciation of the facts that:

1. Rates of return allowed public utilities are controlled primarily by current demands and rates for money, without regard to regulating or law-making bodies.

2. Decisions of commissions made at a time under a particular set of conditions, may have to be revised promptly when the conditions change.

3. The limitation of rates of return to 6, 7 or 8 per cent. as has been held fair by authorities under past conditions, must be increased under existing and probable future conditions if utilities are to secure the additional capital they require.

Temperature Conditions in Coke Ovens.

In a contribution to "Stahl und Eisen" Professor O. Simmersbach, reports on experiments on a Koppers regenerating oven, in which temperature conditions during the period of carbonization, and composition were carefully determined.

The oven was charged with 8¾ tons of coal of 22.7 per cent. of volatile matter, 6.32 per cent. of ash, and 12.1 per cent. moisture; which yielded 79.86 per cent. coke. The coal was carbonized for a period of 29 hours. The temperature rose gradually. The final readings in the centre of the mass were 1090° C. at one-fourth the distance from the charging side, 1120° C. in the center, and 920° C. at one-fourth the distance from the discharge end. In the gas space above the coal the temperatures were respectively 870°, 860° and 810° C. The coke contained 88.53 per cent. of carbon, 2.56 per cent. volatile matter, and 8.91 per cent. ash. The composition of the gas in volume (per centage) during carbonization is shown in the table:

Hours Coal Carbonized	2	3	4	5	6	7	8	9	10	11
CO_2...	3.30	3.0	2.3	2.5	2.2	2.00	1.40	1.90	2.30	1.30
C_6H_6..	1.80	1.5	1.1	1.1	1.0	0.80	0.60	0.50	0.35	0.35
C_2H_4 ..	4.00	3.5	3,1	3.2	2.8	2.50	2.50	2.00	1.75	2.05
O_2....	1.05	0.8	0.6	0.6	0.5	0.50	0.20	0.20	0.20	0.10
CO....	0.90	1.9	2.9	2.8	3.0	3.95	3.40	3.10	2.80	2.80
CH_4...	36.65	36.1	34.5	34.5	33.6	32.40	33.65	33.45	31.20	32.40
H_2	42.50	44.6	48.8	47.8	50.1	50.75	53.75	50.55	47.10	51.50
N_2....	10.00	8.6	6.7	7.5	6.8	7.10	3.60	8.30	14.30	9.50

Hours Coal Carbonized	12	13	15	17	19	21	23	25	27	Heating Gas.
CO_2..	1.50	2.00	1.90	1.80	1.10	1.05	0.80	0.7	1.0	2.1
C_6H_6 .	0.35	0.30	0.25	0.10	..	..	..	..	..	..
C_2H_4 .	1.85	1.80	2.80	1.90	1.20	1.00	0.60	0.3	0.3	1.8
O_2....	0.20	0.20	0.15	0.25	0.15	0.05	0.05	0.1	0.3	0.6
CO...	4.15	4.10	3.90	4.15	4.70	4.00	3.80	4.9	5.8	4.2
CH_4..	33.40	32.45	33.20	30.60	26.10	21.15	18.95	12.2	4.7	26.2
H_2...	50.65	49.75	53.40	51.60	55.75	58.95	61.90	67.0	70.0	51.7
N_2..	7.90	9.40	5.40	8.60	11.00	13.80	13.90	14.8	17.9	15.4

The author also gave results of investigations into the distribution of nitrogen between coke, tar, ammonia, hydrogen, cyanide and free nitrogen in the gas at varying temperatures of distillation; and had experiment on the decomposition of ammonia in contact with coke, into its elements and to form hydrogen cyanide. In the distillation of coal the formation of ammonia occurs mainly at a temperature higher than that of coking. The temperature of maximum ammonia formation for different coals varies between 800° and 900° C. The thermal decomposition of ammonia, which in the case of the pure gas starts at about 750° C., and is very rapid at 800° C., is not appreciable below 900° C. in the conditions of dilution obtaining during the distillation of coal. The hydrogen cyanide formed increases with the quantity of ammonia and with rise of temperature; although when pure ammonia is heated with coke it reaches a maximum at 900° C. The hydrogen cyanide obtained is usually about 1.2 per cent. of the total nitrogen in the coal and 5 per cent of the ammonia formed. Water vapor reduces the cyanide yield and improves that of ammonia; while high velocity of the gas has the reverse effect.

New Methods and Appliances.

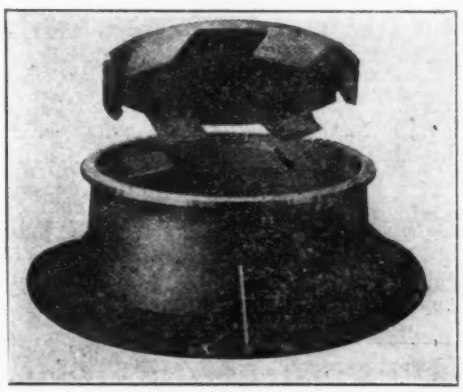
Relative Economy of Gas and Steam Engines.—The gas engine, under favorable circumstances, is a cheap source of energy, particularly in the smaller units, and the large internal-combustion engine has made an excellent record where blast-furnace gases are available. With natural gas or producer gas it does well in units of large size, but with gas of illuminating quality the economic outlook is not good, except in small sizes. Producer systems of considerable size have been used abroad with fair success, and a number are giving good results in this country, without, however, having obtained a sufficient reputation to largely increase their use. At present they seem to be of special rather than general applicability.

In the report of the National Electric Light Association committee on prime movers, it was made clear that in very large units the steam turbine can outrun even producer-gas-engine equipments in thermal efficiency, particularly at loads somewhat below the normal. At full load a 20,000-kw. turbine can operate at a thermal efficiency of 24 per cent. in the turbo-generator itself, and with good boilers the efficiency will come very close to 20 per cent. from coal to electrical energy. Only the oil engine seems able to improve on this efficiency materially, and it is limited to rather moderate sizes. In units, say of 1000 kw. or 2000 kw., the tables are turned, and it is in such cases that the internal-combustion engines more than hold their own.

It must not be forgotten, however, that the large steam turbine is not without a rival in steam efficiency. The high-efficiency reciprocating-engine equipment of the locomobile type is equal to that of the large steam turbine and capable of producing a B. H.P.-hour with 10 pounds of steam, which means less than 14 pounds per kw.-hour, a figure not easily reached in turbines of moderate size.

A Tight Manhole Cover.—The accompanying cut shows the D. and D. safety cover for manholes, the design of which prevents all rattling or dishing of the covers under street traffic. The lugs shown fit into each other very snugly and prevent any noise or motion.

The South Park Commissioners of Chicago have installed the covers on some of the boulevards, and they are also in use by the electrical department of the city of Chicago and by the water department. The dimensions of the 540-pound cover are 24-inch diameter of opening, 36-inch diameter of bottom flange.



Except for the perfect fit of the lid, the cover is in all respects the same as the ordinary manhole required by Chicago specifications. The advantage is in the tightening and wedging of the lugs on the lid upon the lugs on the inside of the manhole ring. The lid is as easy to remove as the ordinary manhole cover lid, because the lugs are so constructed that frost or dirt do not affect the removal.

A New Way to Make Lead Joints.—A new material called "amalgaline" has been introduced in England for making joints between lead surfaces, and it is said to have been widely adopted for flanging and the seaming of lead used in lining refrigerating chambers and the like. The system is not confined to use on small pipes, but is used on pipes varying in bore from 3 inches to 9 inches. It is an autogenous process, but instead of using intense local heat the fusion is effected by the action of the amalgaline on the surfaces to be joined, effecting an amalgamation between the lead of the two surfaces. The material is in the form of a metallic ribbon 0.002-inch thick, practically a pure metal, which, when placed between the surfaces of lead and subjected to heat, fuses at a temperature of 160° F.—lower than the fusing point of lead—and in fusing causes the lead surfaces to run together at the lower melting point. This running together has an autogenous effect, and the minute particles of amalgaline are dissipated into the body of the lead, which, by reason of the absorption, becomes stronger at the junction.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. ARTHUR HEWITT, General Manager of the Consumers' Gas Company, has been elected by acclamation to the position of first vice-president of the Toronto Board of Trade. There seems to be no limit to the number of things Mr. Hewitt can take-on, and keep them all moving.

To relieve office congestion the first few days of the month and make the payment of bills a simpler matter, the Minneapolis, Minn., Gas Light Company has divided the city into three districts with different times of payment for each. The change has been made necessary by the enormous increase in the number of gas consumers. In district No. 1, meters will be read in time to have bills ready on the last day of the month and discount for prompt pay-payment will be allowed if paid within ten days. In district No. 2, readings will be made in time to have bills ready on the 9th, and discount allowed up to the 19th. In district No. 3, bills will be ready on the 19th of each month with the usual ten day discount privilege. After Feb. 10, express company agencies for the collection of bills will be discontinued.

MR. E. L. CALLAHAN, for 6 years Manager of the New Business Department of H. M. Byllesby & Company, having direction of the new business activities of the 35 properties under its management, has resigned that position to become District Manager of the Westinghouse Lamp Company, with offices and headquarters at Chicago. Mr. Callahan takes up his new duties February 1.

THE Board of Selectmen of Franklin, Mass., has received an application for a franchise to manufacture and distribute gas in the town of Franklin, covering all highways under the jurisdiction of the Board. "The quality of the gas to be supplied will be under the supervision of your Board and the Board of Gas and Electric Light Commissioners of Massachusetts, and the rate to be charged per 1,000 cubic feet not to exceed $1.50, with a proviso of a possible discount being allowed on the above figure."

THE City Commission of Eveleth, Minn., has decided to have the gas franchise asked for by John Kennedy and Thomas Lynch printed in the form of an ordinance, that the people may know what is wanted and give their views on the wisdom of granting the privilege.

"GAS LOGIC," printed by the Consolidated Gas Company, New York, reached its "high water mark" in circulation last year. During the year ended December 31, 1914, there have been distributed 525,825 copies of "Gas Logic." During 3 months of the year more than 50,000 copies were distributed each month, and of the December issue 57,200 copies went into the hands of the public. Many of the copies are mailed to private residences and apartments each month, while other copies are mailed to selected businesses where industrial appliances, as advertised in "Gas Logic" would be appreciated.

THE first annual banquet of the Gas and Electric Employees' Association at Ithaca, N. Y., held last week took the form of a send-off for Mr. S. J. Magee, who surrenders the management of the Ithaca Gas Light Company, and a welcome for his successor, J. W. Murdock. The banquet was attended by twenty-one employees of the Ithaca Gas and Electric Company, and Mr. Magee, who has been promoted to the managership of the electric plant at New Brighton, Pa., was presented with a jeweled Masonic watch charm as a mark of appreciation by the men who have worked under him. The presentation speech was made by Mr. Murdock, and Mr. Magee replied with a brief expression of his appreciation, not only for the gift, but for the co-operation and support given him by the employees of the concern. L. C. Boynton acted as toastmaster. Those present included S. J. Magee, J. W. Murdock, L. W. Bennett, G. G. Brown, O. E. Wasser, L. C. Boynton, Charles G. Stumn, John Brooks, Richmond Ide, Frank Robinson, J. A. Burritt, Lawton Pugsley, H. Potter, W. McCann, H. L. Brinkerhoff, George Devauld, Joseph Orr, J. L. Morman, John O'Donnell,

A WINONA, MINN., paper says Manager W. F. Clausen of the Winona Gas Light and Coke Company was asked to ship fifteen cars of Winona made gas coke to the La Crosse Gas and Electric Company, the sale of gas coke at La Crosse having exceeded the production; but the sale for this fuel is increasing so rapidly, says Manager Clausen, that it will take all the coke we have to supply the local demand, and he, therefore, deemed 't wise to refuse the application from La Crosse. Winona people are beginning to realize the worth of gas coke as a domestic fuel.

AN illustrated lecture on "Safety First" was given by Mr. D. M. Cullen, Jr., superintendent of the manufacturing department of the Pittsfield (Mass,) Coal Gas Company, before the employees' association of the company. The lecture was particulary interesting because many of the views shown were local ones. A general discussion and demonstration of some safety devices referred to in the lecture, followed. The lecture was preceded by a business session of the association, attended by about 50 members. The annual election will be in February, and a committee comprising L. F. Keller, R. Schiemenz and J. J. Quinn was appointed to arrange a program for a social evening and reception in honor of the new officers. A luncheon was served and the second number of the association paper "The Illuminator" was distributed.

ARTICLES of incorporation have been filed in California for the formation of the Union Gas Company, the capital stock to be $75,000, 7,500 shares at par value of $10 each, equally divided between C. C. Manker, R. R. Rice, H. H. Dunbar, J. McCosh Smith and Mrs. H. H. Dunbar. The object of the corporation is the manufacture and installation of gas and gas machinery in the State of California, and according to the plans of the corporation, plants will be installed in Susanville, Lassen County; Eagleville and Alturas, Modoc County.

JANUARY 15 was the 62d birthday of illuminating gas in Lynn, Mass. Or perhaps it should be the "burn-day." It was on Jan. 13, 1853, that the first match was touched to the first illuminating gas jet. No houses were piped for gas by that date, but the Lynn Gas Company's new plant was getting ready for business on the present site of the Thomson Electric Welding Company's factory on Pleasant street. Gardner Warren's workmen had erected brick buildings, and the first gas plant in Lynn was, according to the specifications of the contract, to be as good as any of its time.

AT the annual meeting of the stockholders of the Egg Harbor (N. J.) Gas Company the following Directors were elected: Isaac Bacharach, David C. Bradley, Savery Bradley, George K. Brietenall, Clarence L. Cole, Herbert C. Doherty, Brinckle Gummey, M. L. Jackson, Louis Kuenhle, H. McD. Little, James L. O'Donnell. John P. Tompkins and Joseph Thompson.

A BILL will be introduced in the Massachusetts Legislature bringing the management of all municipal gas and electric light plants in the State under civil service. General Manager John J. Kirkpatrick, of Holyoke, is the prime mover in the bill.

A SPECIAL meeting of the stockholders of the Waterbury (Conn.) Gas Light Company was held in the rooms of the Home Club, at The Elton last week. All the stockholders who could attend were present as the meeting was one of unusual importance. It was to discuss the advisability of increasing the capital stock of the concern from $390,000 to $1,000,000. The Waterbury Gas Light Company is owned by the New Haven road.

BLOODHOUNDS trailed the yeggmen who cracked the safe in the office of the St. Clair County Gas and Electric Company, East St. Louis, Ills., and took $800 over the free bridge to the railroad station in the west end of the Eads Bridge, where it is thought the yeggmen boarded a train at 7.30 o'clock in the morning. The dogs, refusing to work after reaching the east tower, were taken to Granite City, where the Burlington crosses from St. Louis over the Merchant's Bridge. The robbery occurred just after several thousand dollars had been removed to a bank and the robbers got only the money paid by late comers.

THE property known as Moxley's field, bound by Florida Street, Third ave., South Second street and the Elizabeth River, Elizabeth, N. J., has been bought by the Elizabethtown (N. J.) Gas Light Co.

IT is reported that the Fitchburg (Mass.) Gas and Electric Light Company will reduce its gas price to $1 per 1,000 cubic feet after April 1st.

THE People's Gas Company of Winnemucca, Neb., is reported to have bought a plot on which to erect a greased-air plant. The process to be used is desbribed as invented by one DeLaitte.

AT the annual meeting of the stockholders of the Newport (R. I:) Gas Light Company the following were elected:

Directors—Clark Burdick, Packer Braman, William R. Hunter, Henry C. Anthony, Andrew K. Quinn.

President—Andrew K. Quinn.

Secretary—Packer Braman.

Mr. Burdick takes the place of the late Thomas A. Lawton on the board of directors and Mr. Braman takes Mr. Lawton's place as secretary.

HOWARD S. ABBOTT, United States Court Commissioner of Minneapolis, has been appointed by Judge Booth of the United States Court as referee to take testimony in the case of the St. Paul Gas Light company against the city to set aside the 75-cent gas rate fixed by the council.

GAS has been turned on in Decatur, Ga., the plant being ready for operation. There were no special ceremonies, but a little group of officials gathered in the Suburban Gas and Electric Company's office and applauded discreetly as the first blue flame crept upward and turned into a cheerful yellow beam. This was in connection with an official test, the result of which was that the pressure was all right and everything set for supplying the city.

THE City Council of Gainesville, Fla., has ordered the light committee to institute an investigation relative to the probable cost of a modern gas plant to be owned by the municipality, and the committee are to report at the earliest date possible. The Gainesville Gas and Electric Power Company own and operate a gas works which covers the city, but members of the council are of the opinion that a majority of the people desire a municipal gas plant in keeping with the great electric and water works plants which were completed the early part of last year.

"I. F.," WRITING from Lakeland, Fla., says: "The Lakeland Gas Company has purchased a site on which to erect their plant, and already material is on the road and work on the plant will begin at the earliest possible moment. Being used principally for cooking purposes, the gas will in no wise come into competition with the municipal electric plant. It is the purpose of the company to erect the plant first, after which the laying of lines will begin. The pipes will be run in the alleys wherever possible, and where this is practicable, rather than disturb the paving, arrangements will be made to bore under the paving, and install the pipes without tearing up the street." It sounds like a good plan.

THE Central New York Gas and Electric Company has a unique way of heating holder tank water. The company's manager at York, John E. McSweeney, began experimenting last fall and found that he could keep the tank from freezing by a hot water circulating system. Fifteen gas-burning coal heaters were installed around the tank, taking cold water from the bottom of the tank and delivering to the top. The holder has a capacity of 100,000 cubic feet of gas.

MANAGER B. K. COOKE of the North Adams (Mass.) Gas Light Company, entertained the office force and heads of departments at the Berkshire Club last week. The speaker of the evening was William Gould, commercial manager of the Massachusetts Lighting Companies. As a result of the gathering, it is probable that permanent organizations of the employees will be formed and meetings held about once a month.

MR. C. M. KELLER, of Richmond, Ind.; President of the Columbus Gas Light Company, has started on a 4 months trip covering Havana and the Panama Canal, down the west coast of South America and returning up the east coast.

THE Western Gas Construction Company, Ft. Wayne, Ind., has been awarded the contract for a 500,000 cubic foot, 3-lift, steel tank holder at Muskegon, Mich., for the Muskegon Traction and Lighting Company.

THE annual bowling contest between teams of the Lynn (Mass.) Gas and Electric Light Co. and those of the Brockton Gas Light Company, resulted in a victory for the Brockton representatives 3 to 1. Deviney of Lynn was high man with 294. After the bowling session the whole crowd, something like 70, went to the rooms of the Brockton Gas Light Association on Centre street, where an appetizing banquet had been prepared. The Lynn delegation left for home in good humor after speech making and some impromtu entertainment.

UTILITIES COMMISSION NEWS.

MUST PAY FOR EXCESS GAS.—The Public Service Commission, Second District, New York, has decided that it cannot prevent the Mohawk Gas Company from shutting off the supply of C. Martin, of Schenectady, if he continues to refuse to pay a bill for gas used in excess of that paid for in a prepayment meter. Commissioner Van Santvoord writes an opinion, concurred in by Commissioner Emmet, in which it is held that the Commission is without power to make the order asked by Mr. Martin. Commissioner Decker holds that the Commission has the power, but that the company has a right to shut off the gas if the bill is not paid. Commissioner Irvine, in an opinion concurred in by Commissioner Hodson, holds that the Commission has the power to prevent the company from shutting off the gas, and that such an order should be made. As three Commissioners concur in the negative no order is issued.

Chairman Van Santvoord, in his opinion, recites the history of the case, showing that the prepayment meter is so built that it shuts off only when ten or a multiple of ten cubic feet of gas has been used. When the rate is $1.20 per thousand cubic feet and the coin a twenty-five cent piece it happens that every coin pays for $208\frac{1}{3}$ cubic feet, while the meter will not shut off until 210 cubic feet have been used, the customer thus getting $1\frac{2}{3}$ cubic feet extra at each payment. There were also other inaccuracies in the meter. From 1910 to February, 1912, sixteen months, the company allowed this surplus to pile up, and then notified its customers of what was due and asked payment. Mr. Martin was the only customer who refused payment on the ground that the prepayment meter presupposed that he paid for all gas consumed. The company did not threaten to cut off the gas supply until last July. Then the matter was submitted to the Commission. A provision in the contract, signed by the complainant, provided that he would pay for all gas used in excess of that paid for in the meter.

ATTACK MISSOURI COMMISSION.—The attack on the constitutionality of tbe act creating the Missouri Public Service Commission and fixing its powers, by attorneys for the Springfield Gas and Electric Company in the application for a temporary injunction to restrain the commission from enforcing rate orders, will affect only the case before the Federal Court and only the clause directly attacked, according to the attorneys for the commission.

The only section that has been attacked in the lighting case is one which authorizes the commission to secure information from sources outside of the evidence submitted to them.

MUST OBSERVE DISCOUNT DATE.—The Pennsylvania Commission has notified Gas and Electric Light and Power Companies that when a company names a period in which a discount will be allowed on bills the discount period must be observed rigidly, and all bills not paid by the expiration of the last discount day must be paid in full.

ORGANIZATION OF UTILITIES BUREAU.—Trustees of the new Utilities Bureau that has been established as an agency for municipalities in dealings with public utility companies, held their first meeting at the University Club, Philadelphia, on Dec. 30. The following were present: Messrs. Louis D. Brandeis, Frederick A. Cleveland, Samuel S. Fels, Charles F. Jenkins and Fred. W. Taylor and Dr. Charles R. Van Hise.

Officers were elected as follows: President, Dr. Charles R. Van Hise, President of the University of Wisconsin; Secretary, Dr. Clyde L. King, Univerity of Pennsylvania; Treasurer, Mr. Samuel S. Fels, manufacturer, of Philadelphia. Mr. Morris L. Cooke, director of public works, of Philadelphia, was made acting director. The bureau was started in connection with the conference of mayors, held in Philadelphia in November last.

BALTIMORE STANDARDS.—At the conference with the Maryland Public Service Commission Mr. Charles M. Cohn, vice-president of the Consolidated Gas, Electric Light and Power Company, made a lengthy statement of the company's views, in effect, as follows:

"That a single heating standard should be adopted in the city; that it should be about 600 British thermal units instead of 645, as before the rate reduction; that because of increases in the cost of manufacture and distribution of gas, this reduction would be justified by the existent facts of the situation, as well as by the testimony of experts that the greatest efficiency in service is had from a standard ranging from 600 down to 576 British thermal units; and that the question of standards and that of rates are separate and should be considered separately by the Commission.

Financial Notes.

STOCKHOLDERS of the ATLANTIC GAS AND ELECTRIC COMPANY have received from the reorganization committee copies of an alternative plan by which an assessment of 25% is levied on them, the company to be merged into the General Gas and Electric Company. The committee states that the company is urgently in need of $670,000 to care for interest payments, floating debt and construction requirements for 1915. Of this amount the General Gas and Electric Company, through W. S. Barstow & Company, has agreed to contribute $270,000, the remainder to be raised from Atlantic Gas and Electric stockholders. The first plan provides for holders of Atlantic Gas and Electric preferred to pay 25% of the par value of their holdiugs and take in return an equal amount of new convertible preferred stock of the General Gas and Electric Company, which will bear dividends of 3% in 1915, 4% in 1916, 5% in 1917 and 6% in 1918 and thereafter. The alternative plan is in two parts. The first calls for a 25% subscription and the second for 22½% subscription of the par value of preferred stock held. Under the 25% payment stockholders will receive for every $250 subscription, $250 in bonds of the Pennsylvania Utilities Company and $125 new convertible preferred and $125 common stock of the General Gas and Electric Company. Under the 22½% subscription, for every $225 paid stockholders will receive $200 par value of 7% preferred, $200 new convertible preferred and $100 common stock of General Gas and Electric Company. Holders of the Atlantic Gas and Electric common stock are permitted to subscribe in the same proportions and will receive an amount of General Gas and Electric common stock equivalent to 50% of their holdings of Atlantic common. No provision is made for stockholders of either class who do not subscribe under one of the plans. The circular states that $1,137,200 of the $2,058,700 preferred stock has been deposited with the committee and 1,073,000 common stock with the New York committee and a considerable amount with the New England committee.

IT is expected that CONSOLIDATED GAS of New York for 1914 will show a gain of about ½ of 1% in combined sales of gas and of between 2 an 3% in sales of electric current, excluding sales to the Third Avenue Railway. The gross from gas approximates $23,-200.000. Gross from residuals or by-products, $2.300,000. Gross from electric output, including $650,000 sales to Third Avenue, $24.800,000. Total operating revenue of the system was somewhat in excess of $50,000,000.

IN connection with the acceptance by the stockholders of the Commercial Tow Boat Company, of the joint offer of the NEW ENGLAND COAL AND COKE COMPANY and the Wooley interests of $150 per share for the physical property of the company, it is rumored that the New England company intends to acquire other properties. The Commercial Tow Boat Company, previous to the sale was under the management of the Darrow-Mann Company, selling agents of the New River Coal Company. While the management of the Darrow-Mann Company and the Massachusetts Gas Companies will make no statement in regard to the matter, it is rumored that the New England Coal and Coke Company is to take over the local Darrow-Mann business in addition to a Providence firm, and that a Portland branch will be established. It is also rumored that the New England company intends to enter the retail soft coal business in and about Boston in connection with its coke trade.

THE PACIFIC GAS AND ELECTRIC COMPANY has applied to the California Railroad Commission for authority to sell its general and refunding bonds at not less than 85 and interest. The Commission July 1, 1914, authorized the company to issue $5,000,000 of these bonds on condition that it should later secure from the Commission a supplemental order specifying the minimum price at which the bonds were to be sold, and application is now made for this order. At the same time that the issue of the bonds was authorized, the company was empowered to issue and sell $12,500,000 of 6% first preferred stock. The gross earnings of the company for the 12 months ended Nov. 30, were $17,155,502, or $1,138,931 larger than those of the previous year. The net earnings were $8,253,507, an increase of $1,528,824.

NOTICES have been sent to the stockholders of the CENTRAL HUDSON GAS AND ELECTRIC COMPANY for the annual meeting in Poughkeepsie, N. Y., or Jan. 26. According to the notice stockholders are called together to receive and act upon reports of the directors and officers; to elect a Board of Directors for the ensuing year; to ratify and approve action of the directors and officers in issuing $300,000 par value of the first refunding 5 per cent mortgage bonds of the company for the obtaining of capital for the extension and improvement of the plant and properties of the company pursuant to the consent of the Public Service Commission of the State of New York therefore obtained and the subsequent sale of said bonds.

THE report of the CENTRAL CALIFORNIA GAS COMPANY for the month of December, 1914, and for the calendar year, as compared with the previous periods, shows a continuation of the healthy growth experienced by the Company since its inception. The gross receipts for December, 1914, show approximately 30% increase over 1913, while the year shows approximately 23% increase in gross and 40% in net over 1913. The company is earning 2.3 times its bond interest.

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